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Open Science

Open Science Philosophy

Open science encompasses unrestricted access to scientific research articles, access to data from public research, and collaborative research enabled by information and communication technology tools, models, and incentives. Broadening access to scientific research publications and data is at the heart of open science. The objective of open science is to make research outputs and its potential benefits available to the entire world and in the hands of as many as possible:

- Open science promotes a more accurate verification of scientific research results. Scientific inquiry and discovery can be sped up by combining the tools of science and information technologies. Open science will benefit society and researchers by providing faster, easier, and more efficient availability of research outputs.
- Open science reduces duplication in collecting, creating, transferring, and re-using scientific material.
- Open science increases productivity in an era of tight budgets.
- Open science results in great innovation potential and increased consumer choice from public research.
- Open science promotes public trust in science. Greater citizen engagement leads to active participation in scientific experiments and data collection.

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Open Society

An open society allows individuals to change their roles and to benefit from corresponding changes in status. Open science depends to a greater or lesser extent on digital technologies and innovations in structural processes by an open society. When realized, open science research and innovation can create investment opportunities for new and better products and services and therefore increase competitiveness and employment. Open science research and innovation is a key component of thematic open science priorities. Central to the open science digital infrastructure is enabling industry to benefit from digital technology and to underpin scientific advances through the development of an open society. Open science research and innovation can also contribute to society as a global actor because scientific relations can flourish even where global relations are strained. Open science has a critical role across many areas of decision making in providing evidence that helps understand the risks and benefits of different open science choices. Digital technology is making the conduct of open science and innovation more collaborative, more global, and more open to global citizens. Open society must embrace these changes and reinforce its position as the leading power for science, for new ideas, and for investing sustainably in the future.

It is apparent in open society that the way science works is fundamentally changing, and an equally significant transformation is taking place in how organizations and societies innovate. The advent of digital technology is making research and innovation more open, collaborative, and global. These exchanges are leading open society to develop open science and to set goals for research and innovation priority. Open science goals are materializing in the development of scientific research and innovation platforms and greater acceptance of scientific data generated by open science research. Open science research and innovation do not need help from open society to come up with great ideas, but the level of success ideas ultimately reach is undoubtedly influenced by regulation, financing, public support, and market access. Open society is playing a crucial role in improving all these success factors.

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Open science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and collaborative tools. These innovations capture a systemic change to the way science and research have been carried out for the last fifty years. Science is shifting from the standard practice of publishing research results in scientific publications after the research and reviews are completed. The shift is towards sharing and using all available knowledge at an earlier stage in the research process. Open science is to science what digital technology is to social and economic transactions: allowing end users to be producers of ideas, relations, and services and in doing so, enabling new working models, new social relationships and leading to a new *modus operandi* for science. Open science is as important and disruptive as e-commerce has been for the retail industry. Just like e-commerce, the open science research paradigm shift affects the whole business cycle of doing science and research. From the selection of research subjects to the carrying out of research, to its use and re-use, to the role of universities, and that of publishers are all dramatically changed. Just as the internet and globalization have profoundly changed the way we do business, interact socially, consume culture, and buy goods, these changes are now profoundly impacting how one does research and science.

The discussion on broadening the footprint of science and on novel ways to produce and spread knowledge gradually evolved from two global trends: Open Access and Open Source. The former refers to online, peer-reviewed scholarly outputs, which are free to read, with limited or no copyright and licensing restrictions, while open source refers to software created without any proprietary restriction and which can be accessed and freely used. Although open access became primarily associated with a particular publishing

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or scientific dissemination practice, open access already sought to induce a broader practice that includes the general re-use of all kinds of research products, not just publications or data. It is only more recently that open science has coalesced into the concept of a transformed scientific practice, shifting the focus of researchers' activity from publishing as fast as possible to sharing knowledge as early as possible. Open science is defined as the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process. As a result, the way science is done in the future will look significantly different from the way it is done now. Open science is the ongoing evolution in the modus operandi of doing research and organizing science. This evolution is enabled by digital technology and is driven by both the globalization of the scientific community and increasing public demand to address the societal challenges of our times. Open science entails the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open science impacts the entire research cycle, from the inception of research to its publication, and on how this cycle is organized. The outer circle reflects the new interconnected nature of open science, while the inner circle shows the entire scientific process, from the conceptualization of research ideas to publishing. Each step in the scientific process is linked to ongoing changes brought about by open science, including the emergence of alternative systems to establish a scientific reputation; changes in the way quality and impact of research are evaluated; the growing use of scientific blogs; open annotation; and open access to data and publications. All institutions involved in science are affected, including research organizations, research councils, and funding bodies. The trends are irreversible, and they have already grown well beyond individual projects. These changes predominantly result from a bottom-up process driven by a growing number of researchers who increasingly employ social media in their research and initiate globally coordinated research projects while sharing results at an early stage in the research process.

Open science is encompassed in five schools of thought:

- the infrastructure school, concerned with technological architecture
- the public school, concerned with the accessibility of knowledge creation
- the measurement school, concerned with alternative impact assessment
- the democratic school, concerned with access to knowledge
- the pragmatic school, concerned with collaborative research

According to the measurement school, the reputation and evaluation of individual researchers are still mainly based on citation-based metrics. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The impact factor is a measure reflecting the average number of citations to articles published in an academic journal and is used as a proxy for the relative importance of a journal.

Numerous criticisms have been made of citation-based metrics, primarily when used, and often misused, to assess the performance of individual researchers. These metrics:

- are often not applicable at the individual level
- do not take into account the broader social and economic function of scientific research
- are not adapted to the increased scale of research
- cannot recognize new types of work that researchers are performing

Web-based metrics for measuring research output, popularized as altmetrics, have recently received much attention: some measure the impact at the article level, others make it possible to assess the many outcomes of research in addition to the number of scientific articles and references. The current reputation and evaluation system has to adapt to the new dynamics of open science and acknowledge and incentivize

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engagement in open science. Researchers engaging in open science have growing expectations that their work, including intermediate products such as research data, will be better rewarded or taken into account in their career development. Vice-versa, the use, and reuse of open data will require appropriate codes of conduct requiring, for example, the proper acknowledgment of the original creator of the data.

These ongoing changes are progressively transforming scientific practices with innovative tools to facilitate communication, collaboration, and data analysis. Researchers that increasingly work together to create knowledge can employ online tools and create a shared space where creative conversation and collaboration can occur. As a result, the problem-solving process can be faster, and the range of problems that can be solved can be expanded. The ecosystem underpinning open science is evolving very rapidly. Social network platforms for researchers already attract millions of users and are being used to begin and validate more research projects.

Furthermore, the trends towards open access are redefining the framework conditions for science and thus have an impact on how open innovation is produced by encouraging a more dynamic circulation of knowledge. It can enable more science-based startups to emerge thanks to the exploitation of openly accessible research results. Open science, however, does not mean free science. It is essential to ensure that intellectual property is protected before making knowledge publicly available in order to subsequently attract investments that can help translate research results into innovation. If this is taken into account, fuller and broader access to scientific publications and research data can help to accelerate innovation. Investments that boost research and innovation in open science would benefit society with fewer barriers to knowledge transfer, open access to scientific research, and greater mobility of researchers. In this context, open access can help overcome the barriers that innovative organizations face in accessing the results of research funded by the public.

Open innovation

An open society is the largest producer of knowledge, but the phenomenon of open science is changing every aspect of the scientific method by becoming more open, inclusive, and interdisciplinary. Ensuring open society is at the forefront of open science means promoting open access to scientific data and publications alongside the highest standards of research integrity. There are few forces in this globe as engaging and unifying as science. The universal language of science maintains open channels of communication globally. Open society can maximize its gains through maintaining its presence at the highest level of scientific endeavor, and by promoting a competitive edge in the knowledge society of the information age. The ideas and initiatives described in this publication can stimulate anyone interested in open science research and innovation. It is designed to encourage debate and lead to new ideas on what and open society should do, should not do, or do differently.

An open society can lead to a research powerhouse; however, open society rarely succeeds in turning research into innovation and in getting research results to the global market. Open society must improve at making the most of its innovation talent, and that is where open innovation comes into play. The basic premise of open innovation is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets while fostering a stronger culture of entrepreneurship. Open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation. This original notion of open innovation was primarily based on transferring knowledge, expertise, and even resources from one company or research institution to another. This notion assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they seek to improve their performance. The concept of open innovation is continually evolving and is moving from linear, bilateral transactions and collaborations

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towards dynamic, networked, multi-collaborative innovation ecosystems. This means that a specific innovation can no longer be seen as the result of predefined and isolated innovation activities but rather as the outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment. This co-creation takes place in different parts of the innovation ecosystem and requires knowledge exchange and absorptive capacities from all the actors involved, whether businesses, academia, financial institutions, public authorities, or citizens.

Open innovation is a broad term, which encompasses several different nuances and approaches. Two main elements underpin the most recent conceptions of open innovation: the users are in the spotlight and invention becomes an innovation only if users become a part of the value creation process. Notions such as user innovation emphasize the role of citizens and users in the innovation processes as distributed sources of knowledge. This kind of public engagement is one of the aims of open science research and innovation. The term 'open' in these contexts has also been used as a synonym for 'user-centric'; creating a well-functioning ecosystem that allows co-creation and becomes essential for open innovation. In this ecosystem, relevant stakeholders are collaborating along and across industry and sector-specific value chains to co-create solutions for socio-economic and business challenges. One important element to keep in mind when discussing open innovation is that it cannot be defined in absolutely precise terms. It may be better to think of it as a point on a continuum where there is a range of context-dependent innovation activities at different stages, from research to development through to commercialization, and where some activities are more open than others. Open innovation is gaining momentum thanks to new large-scale trends such as digitalization and the mass participation and collaboration in innovation that it enables. The speed and scale of digitalization are accelerating and transforming the way one designs, develops, and manufactures products, the way one delivers services, and the products and services themselves. It is enabling innovative processes and new ways of doing business, introducing new cross-sector value chains and infrastructures.

Open society must ensure that it capitalizes on the benefits that these developments promise for citizens in terms of tackling societal challenges and boosting business and industry. Drawing on these trends, and with the aim of helping build an open innovation ecosystem in open society, the open society's concept of open innovation is characterized by:

- combining the power of ideas and knowledge from different actors to co-create new products and find solutions to societal needs
- creating shared economic and social value, including a citizen and user-centric approach
- capitalizing on the implications of trends such as digitalization, mass participation, and collaboration

In order to encourage the transition from linear knowledge transfer towards more dynamic knowledge circulation, experts agree that it is essential to create and support an open innovation ecosystem that facilitates the translation of knowledge into socio-economic value. In addition to the formal supply-side elements such as research skills, excellent science, funding and intellectual property management, there is also a need to concentrate on the demand side aspects of knowledge circulation, making sure that scientific work corresponds to the needs of the users and that knowledge is findable, accessible, interpretable and reusable. Open access to research results aims to make science more reliable, efficient, and responsive and is the springboard for increased innovation opportunities, e.g. by enabling more science-based startups to emerge. Prioritizing open science does not, however, automatically ensure that research results and scientific knowledge are commercialized or transformed into socio-economic value. In order for this to happen, open innovation must help to connect and exploit the results of open science and facilitate the faster translation of discoveries into societal use and economic value.

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Collaborations with global partners represent important sources of knowledge circulation. The globalization of research and innovation is not a new phenomenon, but it has intensified in the last decade, particularly in terms of collaborative research, international technology production, and worldwide mobility of researchers and innovative entrepreneurs. Global collaboration plays a significant role both in improving the competitiveness of open innovation ecosystems and in fostering new knowledge production worldwide. It ensures access to a broader set of competencies, resources, and skills wherever they are located, and it yields positive impacts in terms of scientific quality and research results. Collaboration enables global standard-setting, allows global challenges to be tackled more effectively, and facilitates participation in global value chains and new and emerging markets.

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Scholarly Research Review

The scholarly research review is a multidimensional evaluation procedure in which standard peer review models can be adapted in line with the ethos of scientific research, including accessible identities between reviewer and author, publishing review reports and enabling greater participation in the peer review process. Scholarly research review methods are employed to maintain standards of quality, improve performance, provide credibility, and determine suitability for publication. *Responsible Peer Review Procedure:* Responsible peer review ensures that scholarly research meets accepted disciplinary standards and ensures the dissemination of only relevant findings, free from bias, unwarranted claims, and unacceptable interpretations. Principles of responsible peer review:

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All submitted manuscripts are subject to the scholarly research review process, in which there are three stages of evaluation for consideration: pre-review manuscripts, chair-review presentation, and final-review manuscripts. All submitted full text papers, that may still be withstand the editorial review process, are presented in the conference proceedings. Manuscripts are tracked and all actions are logged by internal and external reviewers according to publication policy. External reviewers' editorial analysis consists of the evaluation reports of the conference session chairs and participants in addition to online internal and external reviewers' reports. Based on completion of the scholarly research review process, those manuscripts meeting the publication standards are published 10 days after the event date.

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Computational Fluid Dynamics Optimization of Supersonic Inlet Geometry

S. Carr, B. Khanal

Abstract— Highly non-linear compressible flow simulations were carried out on a supersonic scramjet inlet under the standard sea level atmospheric conditions. An existing mixed compression inlet geometry designed for a specific inlet conditions has been used for the basic configuration in this research, which was purposed for a cross validation with the available data in the open literature; and thus, be used for further off design analysis. The overall aim of this investigation is to study the flow-field characteristics prevalent in the high-speed intake geometry using Computational Fluid Dynamics (CFD) techniques, and perform an optimization exercise to improve the pressure recovery and shock wave formation for any compromised off-design cases. The results will be analysed in detail and the flow features extraction techniques will be used to identify the shock structures. The on-design CFD simulations were carried out with conditions of $M = 2.1$ at 51,000ft. The results were validated against the available data in the literature with overall good agreement, and it showed the presence of complex shock wave structure in the flow-field. The capturing of the on-design conditions resulted in good oblique shock topology from the external ramp shocks and appropriate reflection shocks downstream of the inlet. The grid domain was generated using a structured mesh topology, and the overall topological design was maintained same for all the cases investigated. The results from the off-design simulation show highly non-linear flow physics characterized by the growth of a bow shock originating at the external ramp; thus, leading to greater discontinuity and separation around the walls of the geometry. With the reduction of free stream Mach number, a retreat of the bow shock occurred towards the leading edge of the inlet. The presence of bow shocks led to some Shock wave Boundary-Layer Interactions at various points along the length of the intake geometry and reduced the performance greatly of the inlet leading to possible unstart; therefore, increasing the possibility of engine surges. Finally, final off design simulation case showed an interesting interaction of oblique shocks emanating from the initial ramp corners and the corner shocks were seen to undergo a gradual merging to a single bow shock. The optimization approach was conducted using compressible gas dynamic relations to further fine-tune the intake geometry with the ultimate aim of improving the shock structure, pressure recovery and to reduce the losses associated with the shock formation. and accurate approximations to the overall parameters of the geometry. Finally, CFD simulation was performed on the optimized geometry to demonstrate the benefit of geometry optimization, the result showed a clear improvement on pressure recovery and shock wave structures, faring favorably over the originating off-design simulation conducted in earlier stages.

Keywords— CFD, compressible flow, design optimization, supersonic ramjet inlet.

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Comparision of Free Vibrations of Euler and Timoshenko Nanobeams Based on Strain-Gradient Elasticity Theory

Ceyda Nur, Reha Artan

Abstract—These paper presents the free vibrations of Euler and Timoshenko beams based on strain gradient elasticity theory with the method of initial values. For the strain-gradient Euler beam (SGEB) and the strain-gradient Timoshenko beam (SGTB), the sixth-order ordinary differential equation and three boundary conditions at each end are obtained by using the Hamilton principle. The frequencies of strain-gradient Euler and Timoshenko beams are found and the results of SGTB and SGEB are compared to the frequencies of classical Euler beam (CEB) and classical Timoshenko beam (CTB). Moreover, the effect of the characteristic length on the frequencies of free vibration is discussed.

Keywords—Characteristic length, free vibration, initial values method, strain gradient elasticity theory.

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The Complexity of Testing Cryptographic Devices on Input Faults

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Abstract. The production of logic devices faces the occurrence of faults during manufacturing. This work analyses the complexity of testing a special type of logic device on inverse, adhesion, and constant input faults. The focus of this work is on devices that implement cryptographic functions. The complexity values for the general case faults and for some frequently occurring subsets were determined and proved in this work. For a special case, when the length of the text block is equal to the length of the key block, the complexity of testing is proven to be asymptotically half the complexity of testing all logic devices on the same types of input faults.

Keywords: complexity, cryptographic devices, input faults, testing

1. Introduction

A logic device with some inputs and outputs is given. The number of inputs and outputs for each given device is fixed. It is assumed that this device when in good condition implements a Boolean function f of n variables. When the function is known, but the correctness of implementation must be checked, the testing method is applied. The main goal is to reduce the time spent on the testing of each device. Statistical methods do not provide with a 100 % certainty in the absence of the faults of the given type and also require a lot of time. The testing approach constructs the exact test set for each type of faults and allows one to have a certainty in the absence of these faults if the testing is successful.

Shannon's function [1] helps measuring the complexity of testing by determining an upper boundary for the size of each test and limit the time required for the test.

1.1. Definitions

The definitions are similar to ones introduced in [1].

$E_2 = \{0, 1\}$. A Boolean cube is E_2^n .

A fault is a mapping $\varphi: E_2^n \rightarrow Q$, where $Q \subseteq E_2^n$.

A checking test for a set of faults $\Phi = \{\varphi \text{ is a fault}\}$ and a function f is a set $T \subseteq E_2^n$ that for any fault $\varphi \in \Phi$ if $f(\varphi) \neq f$ then there exists a vector $\alpha \in T$ such that $f(\varphi(\alpha)) \neq f(\alpha)$.

Faults of the conjunctive adhesion type split the set of variables X^n into non-empty subsets $Z_1(\varphi), \dots, Z_{q\varphi}(\varphi)$, $q\varphi \in N_{n-1}$ so that for any $\alpha \in E_2^n$, $\alpha = (\alpha_1, \dots, \alpha_n)$ we put $\varphi(\alpha) = \beta = (\beta_1, \dots, \beta_n)$, where $\beta_i = \min\{\alpha_j : x_j \in Z_l(\varphi)\}$, if $x_i \in Z_l(\varphi)$, $l \in N_{q\varphi}$, $i = \overline{1, n}$. The notation is $S_{\&}^2$.

Faults of disjunctive adhesion type split the set of variables X^n into non-empty subsets $Z_1(\varphi), \dots, Z_{q\varphi}(\varphi)$, $q\varphi \in N_{n-1}$ so that for any $\alpha \in E_2^n$, $\alpha = (\alpha_1, \dots, \alpha_n)$ we put $\varphi(\alpha) = \beta = (\beta_1, \dots, \beta_n)$, β_i

$= \max\{\alpha_j : x_j \in Z_l(\varphi)\}$ if $x_i \in Z_l(\varphi)$, $l \in N_{q\varphi}$, $i = \overline{1, n}$. The notation is S_{\vee}^2 .

Let \oplus be addition modulo 2 and $\alpha \oplus \beta = \gamma$, where $\alpha_i \oplus \beta_i = \gamma_i$ for all $1 \leq i \leq n$. We put $\text{In} = \{\varphi_\sigma : \sigma \in E_2^n \text{ } (\varphi_\sigma(\alpha) = \alpha \oplus \sigma)\}$. We denote $\tilde{0} = (0, 0, \dots, 0) \in E_2^n$. The set $F_{in}^2 = \text{In} \setminus \{\varphi_0\}$ is called the class of inverse faults.

The set of unit inversion faults is $F_{in}^2(1) = \{\varphi_\sigma \in \text{In} : \sigma \in E_2^n, \|\sigma\| = 1\}$.

The minimum $|T|$, where T is a checking test, is called the complexity of testing a function f for a set of faults K . The notation is $L(f, K)$.

$L(N, K) = \max_{f \in N} L(f, K)$ is called the complexity of testing a set of functions N for a class of faults K .

Constant faults identify some subset of variables as some fixed values. The notation is C^2 .

1.2. Related work

DS Romanov [2] studied the issue of the complexity of testing devices with faults on inputs such as permutation of inputs and gave an upper bound $n \log_2 n$. The result was based on a modification of GR Poghosyan (Lemma 24 from Chapter 3 in [1]). GV Antyufeyev and DS Romanov in [3] determined the complexity of testing logic devices with faults on inputs such as a simple shift equal to 2. In simple shifts, the fault function shifts the variables to the left, and sets the unassigned variables to constant values (these values and the shift value determine this fault). It is worth noting that this work also studied the complexity of diagnosing a fault (determining a specific type of malfunction), the order of which is $2^{n/2}$.

DS Romanov and GV Antyufeyev studied the issue of the complexity of testing for local constant faults in [4]. In local constant faults, only a certain number of consecutive variables are set to constant values. While in [1] the linear complexity of checking tests for all constant faults was shown, the authors demonstrated the exponential (on the number of variables that are set to constants) complexity of the diagnostic test.

EV Morozov and DS Romanov studied the complexity of testing for linear adhesions in [5], in addition, KA Popkov studied certain types of circuits, for example, built only from functional elements with exactly two inputs in [6].

2. Results

A transformation $F : E_2^{n+m} \rightarrow E_2^n$ is called a cryptographic function if for all k in E_2^m the function $F(\cdot, k)$ is a bijective mapping onto E_2^n . The class of all such functions will be denoted by $\text{Cr}(n, m)$. The results from [7] and [8] are further expanded below. The linear and cyclic faults are not covered as they were already presented in [9].

2.1. Inverse faults

Both the complexity of checking for the presence of single inversions at the inputs (a common fault) and checking for the entire class of inverse malfunctions are interesting issues for engineers. The following statement is true:

Theorem 1. $L(\text{Cr}(n, m), F_{in}^2(1)) = m - t$, where $2^{t-1} + t \leq m \leq 2^t + t$.

Proof. Since a fault can occur only at one input and due to the bijectivity of any cryptographic function $F(\cdot, k)$, any set of one vector is a test set to determine the presence of an inversion of one input in the first n variables. Hence, the complexity of testing cannot exceed the complexity of testing a function with m inputs (since any test also checks the first n inputs). The upper boundary is $L(\text{Cr}(n, m), F_{in}^2(1)) \leq m - t$.

The function $F = (f_1, \dots, f_n)$ is as follows:

$$\begin{aligned} f_i(x_1, \dots, x_{n+m}) &= x_i \oplus f_c(x_{n+1}, x_{n+2}, \dots, x_{n+m}) \\ f_c(x_1, \dots, x_m) &= \bigvee_{i=t+1}^m x_i j_{\alpha_i^i}(x_1) \dots j_{\alpha_t^i}(x_t), \end{aligned}$$

where vector α^i is equal to the binary representation of the number i . According to Sentence 12 in Chapter 3 of [1] the complexity of testing the function f_c for single inversion is $m - t$. Then the lower boundary is $L(F, F_{in}^2(1)) \geq m - t$. Combining two boundaries the result is $L(\text{Cr}(n, m), F_{in}^2(1)) = m - t$. \square

Next, the complexity of testing cryptographic functions on all inverse faults is considered.

Theorem 2. $2[(m-1)/2] + 1 \leq L(\text{Cr}(n, m), F_{in}^2) \leq m + 1$.

Proof. An arbitrary vector α is fixed. As any cryptographic function F is bijective on the fixed value of vector k , then for all k in E_2^m the number of vectors $\beta = (\beta_1, \dots, \beta_n, k_1, \dots, k_m)$ such that $F(\beta) \neq F(\alpha)$ is equal to $2^n - 1$ (the function can have a similar value only on one vector among all vectors with the same key value). Therefore, the number of faults $\phi_\sigma \in F_{in}^2$ that can be checked using the vector α is equal to $2^m(2^n - 1) = 2^{n+m} - 2^m$. Hence, the number of unchecked faults is equal to $2^m - 1$ (excluding $\bar{0}$). Based on the Lemma 24 from Chapter 3 in [1] the number of vectors in the smallest checking test cannot exceed $m + 1$.

The lower boundary can be obtained from Theorem 7 in [1] if the function $F = (f_1, \dots, f_n)$ is as follows:

$$f_i(x_1, \dots, x_{n+m}) = x_i \oplus f_{in}(x_{n+1}, \dots, x_{n+m}).$$

where $f_{in}(x_1, \dots, x_{2t+1}) = x_{2t+1} \oplus \sum_{i=1}^t x_{2i-1} \& x_{2i}$. $2t + 1 = m$ is for odd values of m , and $2t + 2 = m$ is for even values of m . \square

2.2. Adhesion faults

As two types of faults S_V^2 and $S_\&^2$ are ambivalent, their complexity of testing must be the same for cryptographic functions.

Theorem 3. $m - 1 \leq L(\text{Cr}(n, m), S_V^2) \leq m + \lceil \log_2 n \rceil$

Proof. Consider a vector in which the first n components are equal to 0, and the remaining components are equal to 1. This vector is called “separating”, since by definition of a cryptographic function it will help to determine whether any adhesion of any of the first n variables with any of the remaining m variables occurs.

A logarithmic system is a system with $\lceil \log_2 n \rceil$ vectors whose weight in the first n components is equal to $n/2$ (in the case of odd n it is equal to $\lceil n/2 \rceil$ or $\lfloor n/2 \rfloor$), as well as the weight of the first n values of the component sum modulo 2 of any of

two vectors from this system is equal to $n/2$ (that is, in the place of half of the units of one vector, the second vector has ones, in the place of the remaining units of the first vector, the second vector has zeros, similarly to half of the zeros of the first vector the second vector corresponds to ones, the remaining zeros of the first vector to zeros of the second vector).

Any adhesion of the first n variables can be determined using any logarithmic system with components from $n + 1$ to $n + m$ being equal to 1.

The logarithmic system makes it possible to reduce the number of unverified adhesion faults of the first n variables by half at each step. Due to bijectivity with respect to the first n variables, any change in the vector will lead to a change in the value of the function. A test for checking m key variables (knowing from previous testing vectors that there are certainly no other adhesions in the device under consideration) can be constructed based on Lemma 20 from [1]. This process requires no more than $m - 1$ vectors in the test set (according to Proposition 6 in [1]). Therefore, the constructed set of vectors is a checking test with $m + \lceil \log_2 n \rceil$ vectors.

The lower boundary can be achieved using $F(x_1, \dots, x_n, x_{n+1}, \dots, x_{n+m}) = (f_1, \dots, f_n)$ with

$$\begin{aligned} f_1(x_1, x_2, \dots, x_n, \dots, x_{n+m}) &= x_1 \oplus (x_2 \& \dots \& x_{n+m}) \\ f_i(x_1, \dots, x_{n+m}) &= x_i \text{ for } 2 \leq i \leq n. \end{aligned}$$

The adhesion of m last variables can be checked with no fewer than $m - 1$ vectors in the test set according to Theorem 5 in [1]. \square

Corollary 1. $m - 1 \leq L(\text{Cr}(n, m), S_\&^2) \leq m + \lceil \log_2 n \rceil$

Theorem 4. The following is true for all $m, n \geq 2$:

$$2(m - 1) \leq L(\text{Cr}(n, m), S_V^2 \cup S_\&^2) \leq 2m + \lceil \log_2 n \rceil.$$

Proof. At first, the two separating vectors (the second one is the inverse of the separating vector in Theorem 3) are used. As $S_V^2 \cup S_\&^2$ means that only one type of fault can be on inputs, not of both types mixed, these two separating vectors allows to consider text and key variables separately. To check adhesion of the first n variables it is enough to use one logarithmic system where components from $n + 1$ to $n + m$ are either all zeros or all ones in order to exclude the adhesion of those variables from consideration. Then, the vectors to check both types of adhesion of variables x_{n+1}, \dots, x_{n+m} should be added. According to Theorem 8 in [1] the resulting set is the test set. Thus, $L(\text{Cr}(n, m), S_V^2 \cup S_\&^2) \leq 2 + \lceil \log_2 n \rceil + 2(m - 1) = 2m + \lceil \log_2 n \rceil$.

The cryptographic function $F(x_1, \dots, x_n, x_{n+1}, \dots, x_{n+m}) = (f_1, \dots, f_n)$ is as follows:

$$\begin{aligned} f_1(x_1, \dots, x_{n+m}) &= x_1 \oplus x_2 \& \dots \& x_{n+m} \oplus \bar{x}_2 \& \dots \& \bar{x}_{n+m} \\ f_i(x_1, \dots, x_{n+m}) &= x_i \text{ for } 2 \leq i \leq n. \end{aligned}$$

As F changes its behaviour only when keys are $(0, \dots, 0)$ and $(1, \dots, 1)$, and when components from 2 to n being equal to key values, then the checking test of adhesion of x_{n+1}, \dots, x_{n+m} must be a union of checking tests for conjunctive and disjunctive adhesions, or $L(F, S_V^2 \cup S_\&^2) \geq 2(m - 1)$. \square

2.3. Constant faults

Only constant faults with the same constant value are considered. The constant faults that assign some variables only

value 1 are denoted as C_1^2 . Similarly, the constant faults that assign some variables only value 0 are denoted as C_0^2 .

Theorem 5. $L(\text{Cr}(n, m), C_v^2) = m + 1$, where $v \in \{0, 1\}$

Proof. The vector α is chosen so that $\alpha_i = \bar{v}$ for $i = \overline{1, n}$, and $\alpha_j = v$ for $j = \overline{n+1, n+m}$. Any constant fault changing value of any one of the first n variables can be checked by α based on the bijectivity of a cryptographic function with the fixed key components. Thus, only constant faults on the rest of the variables need to be checked for. According to Theorem 3 in [1] the complexity of the smallest test on m variables does not exceed m . Adding vector α the full checking test for the function F is obtained. So, the complexity is $L(\text{Cr}(n, m), C_v^2) \leq m + 1$.

Take $F \in \text{Cr}(n, m)$ as $F = (f_1, \dots, f_n)$, where $f_i = x_i$ for $i = \overline{1, n-1}$, $f_n = x_n \oplus g(x_{n+1}, \dots, x_{n+m})$, and $g(x_{n+1}, \dots, x_{n+m}) = j_v(x_{n+1}) \& \dots \& j_v(x_{n+m})$. The function $j_v(x)$ is equal to 1 only when x is equal to v . According to Theorem 3 in [1] the complexity of testing g on constant faults is not less than m . The smallest test set consists of vectors β^i with $\beta_{n+i}^i = \bar{v}$, $\beta_j^i = v$, $j \in \{n+1, \dots, n+m\} \setminus \{i+n\}$. All these vectors can contain arbitrary values in the first $n-1$ variables. However, if any of these vectors has x_n not equal to v , the fault from C_v^2 can be detected, that is not checked by this set: for vector β^k the fault of assigning both variables x_n and x_{n+k} value v is missed. If there are several such vectors, then the fault identifies all corresponding variables and x_n to v . Hence, no vector checks x_n being assigned value v with the remaining variables being unassigned. Therefore, it is not enough to have m vectors in the checking test. So, the complexity is $L(\text{Cr}(n, m), C_v^2) \geq m + 1$. \square

A specific subset of constant faults with only one variable being constant is denoted as $C_v^2(1)$.

Corollary 2. $L(\text{Cr}(n, m), C_v^2(1)) = m + 1$, $v \in \{0, 1\}$

2.4. Special case

According to Shannon [10], a necessary condition for an ideal cipher is the following condition: the cardinality of the key space must not be less than the cardinality of the text space. Therefore, in symmetric block data encryption algorithms, the minimum key size is equal to the text block size. Therefore, the question of assessing the complexity of testing for $m = n$ is of interest. Due to partial bijectivity, these assessments take on a specific form.

Corollary 3. $L(\text{Cr}(n, n), F_{in}^2(1)) \sim \frac{1}{2}L(2n, F_{in}^2(1))$

Proof. According to Theorem 1 the complexity is $L(\text{Cr}(n, n), F_{in}^2(1)) = n - t$, where $2t - 1 + t \leq n \leq 2t + t$. The complexity of testing logic devices on single inverse faults divided by the complexity of testing cryptographic devices on the same type of faults is equal to:

$$\frac{L(2n, F_{in}^2(1))}{L(\text{Cr}(n, n), F_{in}^2(1))} \sim \frac{2n - \lfloor \log_2 2n \rfloor}{n - \lfloor \log_2 n \rfloor} \sim \frac{2n}{n} = 2 \quad \square$$

Corollary 4. $L(\text{Cr}(n, n), F_{in}^2) \sim \frac{1}{2}L(2n, F_{in}^2)$

Proof. Based on Theorem 2 from $n - 1 \leq L(\text{Cr}(n, n), F_{in}^2) \leq n + 1$ the fraction is:

$$L(2n, F_{in}^2) \div L(\text{Cr}(n, n), F_{in}^2) \sim 2n \div n = 2$$

The result for adhesion faults is given below:

Corollary 5. $L(\text{Cr}(n, n), S_t^2) \sim \frac{1}{2}L(2n, S_t^2)$, where $t \in \{v, \&\}$

Proof. Based on Theorem 3 and Sentence 6 in [1] the fraction is:

$$L(\text{Cr}(n, n), S_t^2) : L(2n, S_t^2) = (n+1) \log_2 n : (2n-1) \sim n : (2n) = \frac{1}{2} \quad \square$$

Corollary 6. $L(\text{Cr}(n, n), C_t^2) \sim \frac{1}{2}L(2n, C_t^2)$, where $t \in \{0, 1\}$

Proof. Based on Theorem 5 and Theorem 3 in [1] the fraction is:

$$L(\text{Cr}(n, n), C_t^2) : L(2n, C_t^2) = (n+1) : (2n-2) \lfloor \log_2 n \rfloor \sim n : (2n) = \frac{1}{2} \quad \square$$

3. Conclusion and discussion

Based on the bijectivity of a cryptographic function with any fixed key value the complexity of testing these functions is proven to be asymptotically half of the complexity of testing of all logic devices with the same number of inputs on all main types of input faults. It helps to test encryption devices almost twice faster in comparison with ordinary logic devices.

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5. Conflict of interests

Authors declare no conflict of interests.

References

- [1] Kudryavtsev V B, Gasanov E E, Dolotova O A and Pogoyan G R 2006 *Theory of Testing Logical Devices* (Moscow: Fizmatlit)
- [2] Romanov D S 2011 *Proc. XVI International Conf. Problems of Theoretical Cybernetics* (N.Novgorod) 396.
- [3] Romanov D S and Antyufeev G V 2012 *Proc. XI International Seminar Discrete Mathematics and its Applications* (Moscow: MSU) 163-5.
- [4] Antyufeev G V and Romanov D S 2016 *J. Issues of Radio Electronics* 7 pp.49-51.
- [5] Morozov E V and Romanov D S 2015 *J. Applied and Industrial Mathematics* 9 2 263-70.
- [6] Popkov K A 2019 *J. Discrete Analysis and Operation Research* 26:1 89-113.
- [7] Ikramov A A 2013 On complexity of testing cryptographic devices on inverse input faults *Proc. Lomonosov-2013* (Moscow: MSU)
- [8] Ikramov A A 2014 On complexity of testing cryptographic devices on adhesion input faults *Proc. Lomonosov-2014* (Moscow: MSU)
- [9] Ikramov A 2020 Complexity of testing cryptographic functions on linear and cyclic input faults *Proc. Computational Models and Technologies: Abstracts of the Uzbekistan-Malaysia International Online Conference* 102-4
- [10] Shannon C 1949 Communication Theory of Secrecy Systems *Bell System Technical Journal* 28 (4) 656-715

Neural Networks and Genetic Algorithms Approach for Word Correction and Prediction

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Abstract—Aiming at helping people with some movement limitation that makes typing and communication difficult, there is a need to customize an assistive tool, with a learning environment that helps the user, in order to optimize text input, identifying the error and providing the correction and possibilities of choice in the Portuguese language. The work presents an Orthographic and Grammatical System that can be incorporated into writing environments, improving and facilitating the use of an alphanumeric keyboard, using a prototype built using a genetic algorithm. In addition to carrying out the prediction, which can occur based on the quantity and position of the inserted letters and even placement in the sentence, ensuring the sequence of ideas using a Long Short Term Memory (LSTM) neural network. The prototype optimizes data entry, being a component of an assistive technology for textual formulation, detecting errors, seeking solutions and informing the user of accurate predictions quickly and effectively through machine learning.

Keywords— Genetic Algorithm; Neural Networks; Word Prediction; AutoCorrection; Machine Learning.

I. INTRODUCTION

The identification of writing errors and word placement has always been an educational task, which began in the school environment. Currently, different types of technologies support distance learning, such as Learning Management Systems (LMS) [4], Intelligent Tutoring Systems – STI [5], adaptive hypermedia educational systems (AEHS, Adaptive Educational Hypermedia Systems), with this, it can be noticed that, over time, traditional education has been diversifying and ending the Student-Teacher dependency.

In this scenario, assistive technologies have been standing out with results, one of the best known in the world was used to support a phase of the life of theoretical physicist Stephen William Hawking, who had amyotrophic lateral sclerosis (ALS), a neurodegenerative disease which progressively paralyzes the muscles of the body. In 1985, Intel developed a software called ACAT (Assistive Context Aware Toolkit), which began to interpret his few facial movements and used a speech synthesizer to communicate. The most recent version, developed by Intel and given to Hawking in 2013, tracked the scientist's eye movement to generate words, throughout the product improvement process, Hawking contributed observations of language styles, which allowed him, after receive between 15% and 20% of the characters, the software itself formulate the sentences.

To support the use of an assistive tool for textual communication, there is the implementation of predictive logic to speed up the process. The prediction can occur based on several factors, such as the frequency of the event in the history, however, in order to guarantee the sequence of ideas, one

possibility is to use a prediction that is based on the position of the inserted letters, the amount of and even even the placement in the sentence.

There is a need for personalization of learning that helps the user, not only evaluating and giving the correct answer, but identifying the error and providing correction suggestions.

The main objective of this work is to present a Spelling and Grammar System that can be incorporated into writing environments in order to optimize and facilitate the use of an alphanumeric keyboard, making use of grammar and spelling checkers, including a prototype built using a genetic algorithm, from aspects linked to word structures, use of dictionaries, even factors that influence the context of the sentence structure, being verified through neural networks Long Short Term Memory (LSTM).

II. GENETIC ALGORITHMS (GAS)

Genetic Algorithms (GAs) are computational models that use techniques inspired by biological evolution (natural selection). They are intended to find an optimized solution, or better, a potential solution to a given problem.

The algorithm procedure starts with the evaluation, the suitability of the solutions, which are basically the individuals of the population, is verified. An analysis being carried out to verify how close the population is to the solution of the problem. In selection, individuals are chosen for reproduction. To validate this step, a probability is checked; given a solution i , the probability of being selected is proportional to its suitability. In crossing or reproduction, the characteristics of individuals are recombined, forming a new group of individuals. In mutation, the characteristics of the individuals generated in the previous step are modified, thus forming a new characteristic to the population. In the update, the individuals generated in the previous steps are inserted into the population. Finally, the finalization, responsible for checking the closing conditions, determining if a certain population reached an optimal solution, otherwise, the entire previous process is executed again.

III. LSTM NETWORKS (LONG SHORT TERM MEMORY)

The formation of human thought does not start from scratch, the understanding of a situation is based on the use of previous memories. A simple reading of a text does not happen instantly, knowledge about words, ideas and previous information is retrieved. At all times the brain processes information, seeking it, storing it or eliminating it.

Similarly, neural networks called LSTM have the ability to both remember and forget the previous state, defining whether or not the information is relevant to the process.

LSTM Networks are a special type of recurrent neural network as they are able to learn long-term connections. As such, they have incredible predictive power and work very well on a wide range of problems and are widely used today.

This type of recurring network has the ability to retain information from a greater amount of past entries (long-term memory) while maintaining the relevance of recent states as greater. For this, the LSTM makes use of structures called cell state (c) and hidden state (h), which are responsible for transporting information through the network's neurons, as can be seen in Figure 1.

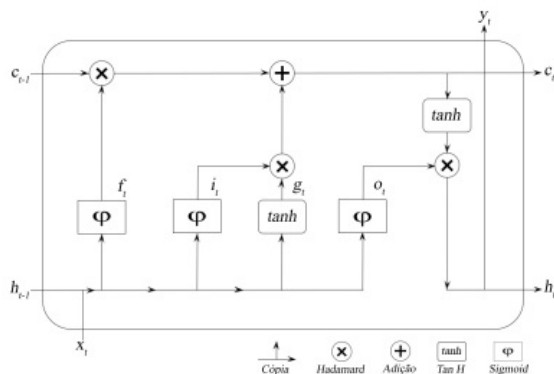


Figure 1: Block Structure of an LSTM Network

IV. APPLICATION DEVELOPMENT

The lack of a database that contemplates the daily reality of someone who needs attention and care most of the time has meant that phrases involving requests and responses were added to a new set of data. The most recurrent words for training are shown in Figure 2.



Figure 2: Most recurrent words

Initially, the system captures the text input performed on the interface, separates each word from this input to carry out the individual verification and correction process. The words are first compared with the database with the most usual items to the user's vocabulary, if not identified, the existence of the word will be checked in an auxiliary dictionary. When the word is found correctly, the process keeps it and evaluates the next typed. When there is no typed term, the system performs processes for a possible identification of the text. Anagrams are generated with the input word and these grams are compared to the auxiliary dictionary words to find how close to some correct word the entered term is. Each letter in the correct position

represents a point, at the end the points of each word are added, which represent the fitness of each individual. The selection of the initial population is made from the words with greater fitness and the greater the number of correct letters, the greater the probability of each individual participating in the crossing.

The system accepted crossover at a single point, with a crossover rate equal to 0.9, which guarantees a high chance that the crossing will happen, mutation probability equal to 0.8, an important factor, because when the word and not even the anagrams are found in the dictionary, the word may have different letters, more or less letters, the mutation makes new characters participate in the crossing. The mutation forces a random letter into a random position of the selected individual. The stopping criterion was based on the number of generations, with a maximum of 2000 per call of each word.

In order to define a research trend, the formation of a new population depends on the comparison between the fitness of parents and children, moving to the next selection the individuals with the two highest fitness among the four compared. New populations are formed until the word is found or up to a maximum of 2000 repetitions. When the word is not found, the algorithm calls the function one more time, guaranteeing a random process.

From the moment the words were corrected, the next process is the prediction through the existing sentence, in order to check the usage memory and present suggestion results. The network was implemented through a sequential input layer with only one dimension, a word embedding layer with 20 dimensions, an LSTM layer with 80 hidden units, a connection layer with 32 units, a Softmax layer (to carry out the normalization) and a classification layer (output). The network training took place with 500 iterations, with a learning rate of 0.001 and a mini batchsize of 32, which is related to the amount of data used to update the weights.

V. RESULTS AND DISCUSSION

The application of the software was carried out in a database of usual words previously created and in a dictionary formulated using existing and correct texts. Although it is in a restricted sample, the possibility of application to a population context is notorious, the increase in the dictionary and in the database of usual words makes the algorithm more efficient.

The help in the correction process was remarkable, with predictive capacity in more than 90% of the input cases and accuracy above 95%, as the algorithm was effective to estimate words missing letters or with too many letters, as long as there was fitness for the comparison with the dictionary.

In figure 4, we have the result of the simulation of the algorithm, we observe that as the number of iterations increases, the accuracy increased, until reaching 75% when it stagnated after approximately 190 iterations, but it can still be observed that the error kept falling even after 350 iterations.

Even with a relatively low accuracy, 75%, the network performed very well, being able to predict words that fit the context.

Santos et al., 2015, proposed an orthographic-grammatical analyzer for handwriting assessment. In his approach, the author used Genetic Algorithms. The module that works in spell

checking uses Levenshtein distance while optimizing correction suggestions generated by AG.

A similar work was developed by Junior and Oliveira, 2016, where a system for automatic evaluation of ENEM essays was proposed. With 954 essays on the UOL website, it obtained 0.313 points of absolute mean error, 35% accuracy and 47% recall.

VI. CONCLUSION

The interest was to evaluate the orthographic and syntactic structure of sentences received through an assistive signal capturing technology or a conventional keyboard, in order to detect errors, seek solutions and inform the user of accurate predictions quickly and effectively through learning resources of machine, the Genetic Algorithm and the Artificial Neural Networks.

The system's response was decisive, as it helped in the correction process with prediction capacity and accuracy above 90%, with high performance to estimate words missing letters or with more letters, as long as there was fitness for comparison with the dictionary.

In this article, it was possible to show the need for assistive technologies and their importance in people's lives. In addition, tools that predict words for sentence formation in Portuguese are very scarce, emphasizing the need for developments in this area.

The integrated system with Artificial Neural Networks makes it possible to evaluate the orthographic and syntactic structure in the input sentences of the interface, mainly correcting errors due to the use of a crasis, gender, number and even inadequate placement of a term.

REFERENCES

- [1] Alpaydin, E. *Introduction to machine learning*. [S.l.]: MIT press, 2014.
- [2] BASTOS, I.G.P.; GOMES, G.C. ARAÚJO, I.B.Q. et al. Previsão de Geração Fotovoltaica A Partir de Dados Meteorológicos Utilizando Rede Lstm. VIII CBES. 2020.
- [3] Costa, L. F.; Oliveira, E. H. T.; Júnior, A. N. C. *Corretor Automático de Redações em Língua Portuguesa: um mapeamento sistemático de literatura*. IX Congresso Brasileiro de Informática na Educação, CBIE 2020.
- [4] Haykin, S. *Redes Neurais –Princípios e Prática*, Bookman, Rio Grande do Sul, 2001.
- [5] Hochreiter, S., Schmidhuber, J., “*Long Short-Term Memory*”, Neural Computation 9 (8), 1997, pp. 1735–1780.
- [6] Júnior, C. R. C. A. E Oliveira, E. (2016) “*Proposta de um sistema de avaliação automática de redações do ENEM*”. Workpedia 2016 - Workshop de Pesquisa e Desenvolvimento em IA, Inteligência Coletiva e Ciência de Dados, Niterói, RJ, Brasil.
- [7] Russel, S.; Norvig, P. *Artificial Intelligence -A Modern Approach*, Prentice Hall, New York, EUA, 2003.
- [8] Santos, J; Paiva, R; Bittencourt, IG. *Avaliação automática de atividades escritas baseada em algoritmo genético e processamento de linguagem natural: Avaliador Ortográfico Gramatical. Concurso de Teses e Dissertações em Informática na Educação*. CBIE, p.95, 2015.
- [9] Silva, I. N. DA; Sapatti, D. H.; Flauzino, R. A. *Redes Neurais Artificiais: Para Engenharia e Ciências Aplicadas*. São Paulo: Artliber, 2010.

Covering a Set of Remotely Controlled Sectors of Arbitrary Shapes by a Multi-Beam Antenna

Mohamed Sanad and Noha Hassan

Abstract—A multi-beam base station antenna has been developed using dual parabolic cylindrical reflectors. It can generate an arbitrary number of beams, which significantly increases the capacity and reduces the need for spatial multiplexing MIMO (Multi-Input Multi-Output). The $\pm 45^\circ$ polarized feeds can be replaced by single-port orthogonally polarized feeds, which significantly reduces the need for spatial diversity MIMO. Each beam can be remotely-electrically tilted with an arbitrary vertical tilt angle. So, the antenna can cover a circle of an arbitrary diameter. Alternatively, it can cover a set of sectors having arbitrary shapes and sizes by remotely controlling the vertical tilt angle of each beam. Moreover, the antenna can cover a fixed area while it is mounted on a quasi-stationary platform (aircraft) with a movement in all directions. As the aircraft moves in any direction, a fixed area can always be covered by automatically and remotely adjusting the vertical tilt angle of each beam. The moving parts (the feeds) of the antenna are very small in size and weight and they are fully enclosed inside the radome of the antenna. So, their movement (for beam tilting) will not even be detected by the platform.

Index Terms— 5G mobile communication, aperture antennas, broadband antennas, directive antennas, reflector antennas.

I. INTRODUCTION

In order to increase the wireless communication network capacity, the number of sectors has to be increased such that each antenna serves a smaller area. So, multibeam antennas make extensive coverage for higher data rates [1]-[4]. A foldable/deployable 5G multi-beam base station antenna was developed by the authors of this paper as was shown in references [5]. It could cover the whole sub-6GHz band (3.3-7.0GHz) or the mm-wave band (24-34GHz). It consisted of two parabolic cylindrical reflectors and a set of small size broadband resonant feeds as shown in Fig. 1, where four of these units were used to cover the whole azimuth. The geometry of the feed antenna is shown in Fig. 2. The feed consisted of three arms, two of them were directly fed while the third arm was fed by coupling. The dimensions of the sub-6GHz feed were published in reference [6].

The proposed antenna could generate an arbitrary number of beams with arbitrary vertical and horizontal beamwidths, arbitrary beam overlapping and arbitrary electric beam-tilt for each beam [5]. Furthermore, the beams could be shaped in the elevation plane in order to eliminate any possible ducting and/or interference with the surrounding base station antennas. Multi-beam technology could be easily applied to the dual parabolic cylindrical reflector antenna by adding

multi-feeds as was shown in Fig. 1(a). Shifting the location of any feed away from the focus of the sub-reflector resulted in tilting the beam that was generated by this feed. Thus, each beam could be easily tilted vertically and/or horizontally by remotely shifting its feed. Furthermore, an array of these feeds with different horizontal and vertical shifts could be used together to generate a simultaneous horizontal and vertical sectorization.

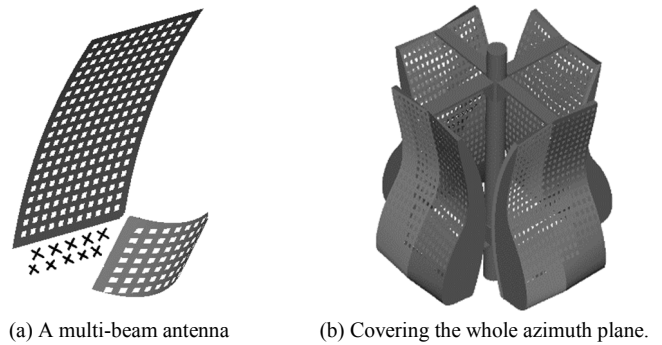


Fig. 1. Base station antennas using dual parabolic cylindrical reflectors



Fig. 2. Geometry of the feed antenna

The proposed antenna could generate an arbitrary number of beams with arbitrary vertical and horizontal beamwidths, arbitrary beam overlapping and arbitrary electric beam-tilt for each beam [5]. Furthermore, the beams could be shaped in the elevation plane in order to eliminate any possible ducting and/or interference with the surrounding base station antennas. Multi-beam technology could be easily applied to the dual parabolic cylindrical reflector antenna by adding multi-feeds as was shown in Fig. 1(a). Shifting the location of any feed away from the focus of the sub-reflector resulted in tilting the beam that was generated by this feed. Thus, each beam could be easily tilted vertically and/or horizontally by remotely shifting its feed. Furthermore, an array of these feeds with different horizontal and vertical shifts could be used together to generate a simultaneous horizontal and vertical sectorization.

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This research was fully financed by and assigned for Amant Antennas.

The $\pm 45^\circ$ polarization feeds are used in spatial diversity MIMO, where the same data are sent to provide a more reliable link, or in spatial multiplexing MIMO, where independent data streams are sent to increase link capacity. In this paper, a broadband resonant single port orthogonally polarized feed antenna has been used to considerably reduce the need for spatial diversity MIMO. It is equally sensitive to two perpendicular polarizations ($\pm 45^\circ$). Thus, the two spatially separated $\pm 45^\circ$ polarization feeds can be replaced by an orthogonally polarized feed with a single port. On the other hand, the need for a spatial multiplexing MIMO may be significantly reduced in this multi-beam antenna because of its high capacity with its large number of beams and wide frequency bandwidth [7].

II. REDUCING THE NEED FOR SPATIAL DIVERSITY MIMO

As mentioned above, the developed multi-beam base station antenna can generate a large number of beams (up to 60 beams with 120 ports for $\pm 45^\circ$ polarizations). The $\pm 45^\circ$ polarizations are used in spatial diversity MIMO and/or in spatial multiplexing MIMO. The need for a spatial multiplexing MIMO can be significantly reduced in this multi-beam antenna because of its high capacity with its large number of beams and wide frequency bandwidth. To considerably reduce the need for spatial diversity MIMO, a broadband resonant single port orthogonally polarized feed antenna has been developed to cover the 5G Sub-6GHz spectrum (3.3-7.0GHz) or the mm-wave spectrum (24-34GHz). It is equally sensitive to two perpendicular polarizations ($\pm 45^\circ$). Thus, the two spatially separated $\pm 45^\circ$ polarization feeds can be replaced by an orthogonally polarized feed with a single port. So, the number of ports becomes equal to the number of beams.

As a sample configuration, four sub-6 GHz penta-beam antenna units were used, where each of them produces five beams in each 90° azimuth main-sector [5]. With four of these penta-beam units, 20 beams with 40 ports ($\pm 45^\circ$ polarizations) were generated to cover the whole azimuth plane (360°) with an arbitrary electric vertical/horizontal beam tilt for each beam. The return loss of the above 5G sub-6GHz configuration was always better than 14 dB over the whole frequency band (3.3-7.0GHz). A sub-6GHz multi-beam antenna unit was manufactured by a 3D printer and then the reflecting portions/faces were covered by a very thin layer of aluminum foil/tape. The length/width of the main reflector were 80/56cm. The length/width of the sub-reflector were 17/56cm. The focal lengths of the main/sub reflectors were 40/20cm. The overall weight of each multi-beam unit with the radome was around 2kg. Thus, the overall weight of the switched-beam antenna that covers the whole azimuth with three/four units was about 6/8kg. The radiation patterns of the antenna are shown in Fig.3 in the azimuth and elevation planes. The gain of the manufactured configuration was ranging from 20 to 24dBi and the front-to-back ratio at 180° is ≥ 30 dB. The 1st upper side lobe suppression was 15dB and the isolation between polarizations as ≥ 20 dB. The isolation between beams was ≥ 21 dB. Moreover, each beam could be electrically tilted by an arbitrary tilt angle.

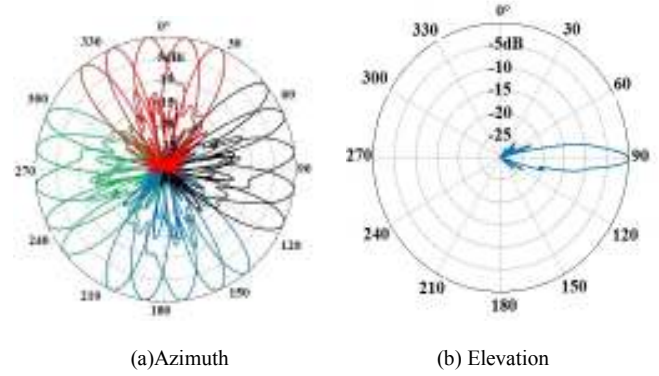


Fig. 3. Four penta beam antenna units covering 360° with 20 beams

III. ORTHOGONALLY POLARIZED FEEDS

The $\pm 45^\circ$ polarization feeds of the above switched beam base station antenna are used in spatial diversity MIMO, where the same data are sent to provide a more reliable link, or in spatial multiplexing MIMO, where independent data streams are sent to increase link capacity. The need for a spatial multiplexing MIMO may be significantly reduced in this switched-beam antenna because of its high capacity with its large number of beams and wide frequency bandwidth. To considerably reduce the need for spatial diversity MIMO, a broadband resonant single port orthogonally polarized feed antenna has been developed to cover the 5G sub-6GHz (3.3-7.0GHz) or the mm-wave (24-34GHz). It is equally sensitive to two perpendicular polarizations ($\pm 45^\circ$) [7]. Thus, the two spatially separated $\pm 45^\circ$ polarization feeds can be replaced by an orthogonally polarized feed with a single port. So, the number of ports becomes equal to the number of beams. The arms of the developed orthogonally polarized feed antenna are bent by 90° where the location of the pending point is optimized such that the feed is equally sensitive to two perpendicular polarizations. Fig.4 shows a 5G sub-6GHz (3.3-7.0GHz) orthogonally polarized feed while its detailed dimensions can be found in reference [7]. The single port orthogonally polarized feed antenna could also be used in smart phones, tablets, IoT terminals and mobile handsets to significantly reduce their need for MIMO. Actually, MIMO technology is not easy to achieve on mobile handsets due to the complications in decoupling between MIMO antennas that appear when dealing with a small volume of the mobile handset [7].

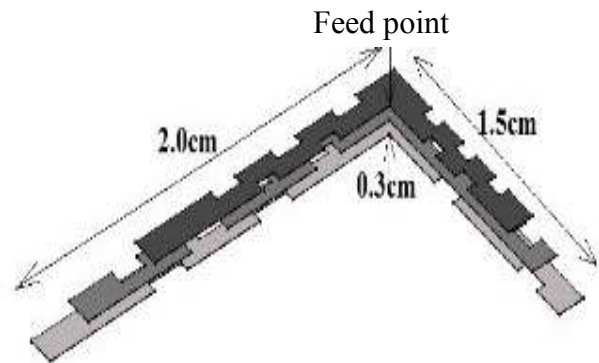


Fig. 4. A 5G sub-6GHz (3.3-7.0GHz) orthogonally polarized feed antenna

The orthogonally polarized feeds are used with the above base station antenna configurations as shown in Fig. 5. For example, Fig. 6 shows the total gain and its $\pm 45^\circ$ components for the above 5G sub-6GHz penta beam configuration with one row of orthogonally polarized feeds at a sample frequency 4 GHz. It covers the whole azimuth with 20 beams and 20 ports instead of 40 ports. On the other hand, to further increase the number of the generated beams, a simultaneous vertical and horizontal sectorization can be achieved. For example, three orthogonally polarized feed rows are used together with the penta-beam configuration to cover the whole azimuth plane (360°) with 60 beams and 60 ports as shown in Fig. 7. The total gain is ranging from 20 to 24 dBi. The $+45^\circ$ and -45° components are close to each other, where each of them is about half of the total gain (i.e. -3dB). Furthermore, the number of ports of all these base station antennas is equal to the number of beams due to replacing the two spatially separated $\pm 45^\circ$ polarization feeds by an orthogonally polarized feed with a single port.

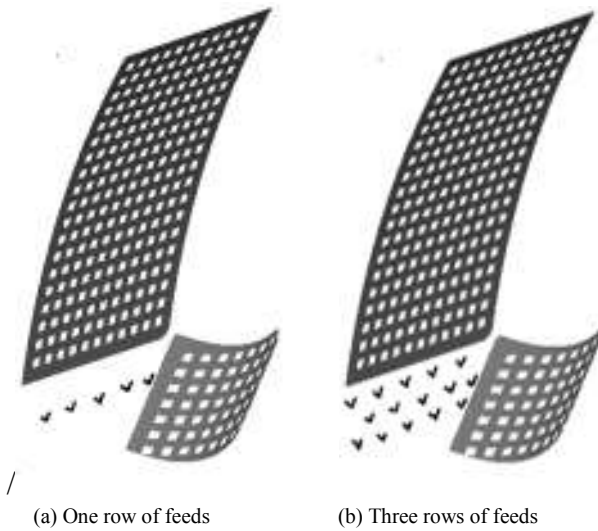


Fig. 5. An orthogonally polarized multi-beam dual parabolic cylindrical reflector antennas.

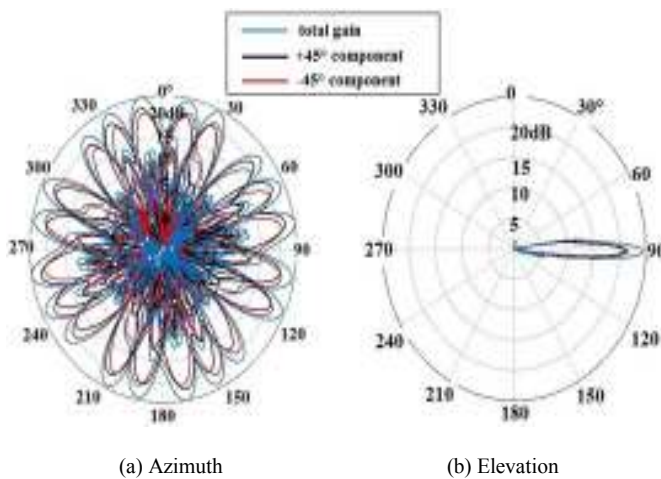


Fig. 6. Total gain and $\pm 45^\circ$ components - One row of feeds generating 20 beams with 20 ports at 4GHz.

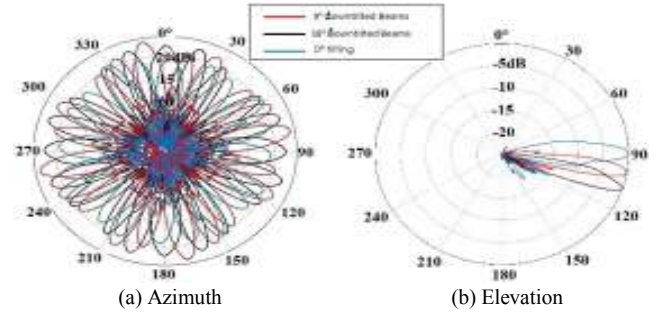


Fig. 7. Total gain and $\pm 45^\circ$ components - Three rows of feeds generating 60 beams with 60 ports at 4GHz

IV. COVERING A SET OF AREAS BY A MULTI-BEAM ANTENNA ON A QUASI-STATIONARY PLATFORM

If all beams of the developed multi-beam antenna are adjusted to have equal vertical tilt angles, they will cover a circular area around the antenna (360°) as was shown in Fig.3. The radius of this covered circle depends on the height of the antenna (along the z-axis) and the vertical tilt angles of the beams. The radius of the covered area increases by decreasing the vertical tilt angles of the beams and vice versa. To significantly increase the radius of the covered circle, more vertical arrays of beams can be used with a simultaneous vertical and horizontal sectorization. Instead of covering a circle, the antenna can also cover any area of an arbitrary shape and size by controlling the vertical beam-tilt of each beam individually. Each beam can be individually tilted with an arbitrary remote electric vertical beam-tilt. This means that the vertical beam tilt of all beams (up to 60 beams) can be different from each other, if needed. Furthermore, the beams can be divided into different groups of beams to cover different areas of arbitrary shapes and sizes (a circle, quasi-ellipse, quasi square, quasi-rectangle, quasi triangle, half a circle, ----- etc.). It should be noted that these concepts require a large number of beams such as the above 60 beam configuration. With the $\pm 45^\circ$ polarization feeds, the number of ports will be twice the number of beams, which will be very difficult to handle. To overcome this problem, the $\pm 45^\circ$ polarization feeds, are replaced by an orthogonally polarized feed with a single port. So, the number of ports becomes equal to the number of beams.

On the other hand, sometimes, the antenna is required to cover fixed areas while it is mounted on a quasi-stationary platforms (e.g. Aircrafts) with a movement in all directions (along x, y and z-axes) as shown in Fig.8. Again, this can be achieved by controlling the vertical beam tilt angle of each beam. If the height of the Aircraft changes (along the z-axis), the antenna can keep covering the same area by automatically and remotely controlling the vertical tilt angles of all the beams. The exact relationship between the height and the vertical beam tilt angles can be accurately estimated and programmed to be modified remotely and automatically in order to cover a fixed area. If the height of the Aircraft increases, the beams have to be rotated upwards and if the height decreases, the beams have to be rotated downwards in order to keep the covered area constant. It should be noted that some aerospace applications use high frequency bands such as Ku and Ka bands. Hence, the antenna size will be much smaller than that of the 5G antenna. Furthermore, the four antenna units that cover the whole azimuth can be distributed along the back, the front and the two corners between the aircraft and its two wings.



Fig. 8 The antenna on a quasi-stationary Aircraft

If the Aircraft moves in the x-y plane, the antenna can still cover the same area by changing the vertical tilt angles of the different beams by different values. The beams in the direction of the movement of the Aircraft in the x-y plane rotate upwards while the beams in the opposite direction rotate downwards. Again, the vertical tilt angle of each beam can be accurately estimated and programmed to be remotely and automatically adjusted in order to cover the same area. Thus, as the Aircraft moves in any direction (x-, y- and z-) a fixed area can always be covered by automatically and remotely changing the vertical tilt angle of each beam according to an accurately estimated values. The moving parts of the antenna (the feeds) are very small in size and weight and they are fully enclosed inside the radome of the antenna. So, their movement (for beam tilting) will not even be detected by the platform. On the other hand, since the Aircraft keeps changing its direction, it is necessary to use one of the complicated spatial diversity MIMO techniques to overcome the problem of the randomly changing wave polarization. Again, the need for these MIMO techniques can be significantly reduced by using the new developed single port orthogonally polarized feeds. .

V. CONCLUSION

A multi-beam base station antenna was developed. It could cover the whole sub-6GHz band (3.3-7.0GHz) or the mm-wave band (24-34GHz). It consisted of dual parabolic cylindrical reflectors. The developed antenna could cover the whole azimuth plane (360°) with an arbitrary number of beams up to 60 beams with 120 ports ($\pm 45^\circ$ polarizations) and with an arbitrary electric vertical/horizontal beam tilt for each beam. Furthermore, each beam could be remotely tilted with an arbitrary vertical and horizontal tilt angles by remotely shifting its feed. So, if required, the vertical and horizontal tilt angles of all beams could be different from each other regardless of their number.

The developed multi-beam antenna had a high capacity because of its large number of beams and its wide frequency bandwidth. Hence, the need for the spatial multiplexing MIMO could be significantly reduced. To reduce the need for spatial diversity MIMO, a broadband resonant single port orthogonally polarized feed antenna has been developed. It was equally sensitive to two perpendicular polarizations

($\pm 45^\circ$). Thus, the two spatially separated $\pm 45^\circ$ polarization feeds were replaced by an orthogonally polarized feed with a single port. So, the number of ports became equal to the number of beams. The $+45^\circ$ and -45° components of the radiation patterns were close to each other, where each of them was about half of the total gain (i.e. -3dB). The single port orthogonally polarized antenna could also be used in IoT terminals and mobile handsets to reduce the need for spatial diversity MIMO.

The use of single port orthogonally polarized feeds enabled the developed multi-beam antenna to be used in different complicated applications. The antenna could cover a circle of an arbitrary diameter. It could also cover any area of an arbitrary shape and size by controlling the vertical beam-tilt of each beam individually. Furthermore, it could be remotely controlled to cover any set of areas having any specific shapes with any required sizes (e.g. a circle, quasi-ellipse, quasi square, quasi-rectangle, quasi triangle, half a circle, ----- etc.). This required generating a large number of beams (60 beams). Hence, it was necessary to use single port orthogonally polarized feeds to reduce the number of ports.

The antenna could also cover fixed areas while the antenna was mounted on a quasi-stationary platforms (Aircrafts) with a movement in all directions (along x, y and z-axes). As the Aircraft moves in any direction (x-, y- and z-) a fixed area could always be covered by automatically and remotely changing the vertical tilt angle of each beam according to an accurately estimated values. The moving parts of the antenna (the feeds) are very small in size and weight and they are fully enclosed inside the radome of the antenna. So, their movement (for beam tilting) would not even be detected by the platform. On the other hand, since the Aircraft might keep changing its direction, it was necessary to use one of the complicated spatial diversity MIMO techniques. The need for MIMO techniques could be significantly reduced by using single port orthogonally polarized feeds.

REFERENCES

- [1] A.K.MFazlulHaque, Mir Mohammad Abu Kyum, Md. Baitul Al Sadi, Mrinal Kar and Md. Fokhray Hossain, "Performance Analysis of UMTS Cellular Network using Sectorization Based on Capacity and Coverage", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 2, No. 6, 2011.
- [2] L. Shen, H. Wang, E. Willis, W. Lotz, H. Jamali, "Compact Dual-Band Interleaved Multi-Beam Base Station Antenna", 2020 IEEE Symposium on Antennas and Propagation
- [3] W. Wu, Z. Zhang, Y. Zhao, Q. Liu, C. Wang, Y. Zuo, "Design of Multi-Beam Antenna Based on Rotman Lens", 2019 International Applied Computational Electromagnetics Society Symposium - China (ACES)
- [4] N. Herscovici, "A Highly Efficient, Multi-beam, Wide Scan Angle Antenna", 2020 IEEE International Symposium on Antennas and Propagation
- [5] M. Sanad and N. Hassan, "A 5G Sub-6GHz Switched-beam Smart Base Station Antenna with an Arbitrary Remote Electric Tilt for Each Beam", Microwave Journal, Online Spotlight article, Nov 2020, <https://www.microwavejournal.com/authors/4817-mohamed-sanad-and-noha-hassan-cairo-university-giza-egypt>
- [6] M.Sanad and Noha Hassan, "Orthogonally Polarized MIMO LTE/5G Terminal Antennas for Handsets and IoT Applications," 2019 IEEE Radio and Wireless Symposium (RWS2019), Orlando, FL, USA, January 2019.
- [7] M.Sanad and Noha Hassan, "A Single Port Orthogonally Polarized Antenna for Handsets, IoT Terminals and Vehicles," 2020 14th European Conference on Antennas and Propagation (EuCAP), Copenhagen, Denmark, March 2020

Reducing the Need for Multi-Input Multi-Output in Multi-Beam Base Transceiver Station Antennas Using Orthogonally-Polarized Feeds with an Arbitrary Number of Ports

Mohamed Sanad, Noha Hassan

Abstract—A multi-beam BTS (Base Transceiver Station) antenna has been developed using dual parabolic cylindrical reflectors. The $\pm 45^\circ$ polarization feeds are used in spatial diversity MIMO (Multi-Input Multi-Output). They can be replaced by single-port orthogonally polarized feeds. Then, with two sets of beams generated above each other, the $\pm 45^\circ$ polarization ports of any conventional transceiver can be connected to two of these beam sets. Thus, with two-port transceivers, the system will be equivalent to 4x4 MIMO, instead of 2x2. Radio Frequency (RF) power combiners/splitters can also be used to combine the multiple beams into a single beam or any arbitrary number of beams/ports. The gain of the combined-beam will be more than 20-24 dBi instead of 17-18 dBi of conventional wide-beam antennas. Furthermore, the gain of the combined beam will be high over the whole beam angle. Moreover, the users will always be close to the peak gain value of the combined beam regardless of their location within the combined beam angle. The frequency bands of all the combined beams are adjusted such that they all have the same frequency band. Different configurations of RF power splitter/combiners can be used to provide any arbitrary number of beams/ports according to the requirements of any existing base station configuration.

Keywords—5G mobile communications, BTS antennas, MIMO, orthogonally polarized antennas, multi-beam antennas.

I. INTRODUCTION

MULTIBEAM antennas create narrow beams limited to a fixed number of scan directions. They can make extensive coverage for higher data rates. Different antenna techniques can be used to generate multi-beams [1]-[5]. Dual parabolic cylindrical reflector antennas were also used to generate multi-beams. Their basic concept and their broadband resonant feeds were originally invented in [6]. We developed a foldable/deployable 5G multi-beam base station antenna as shown in [7]. It could cover the whole sub-6GHz band (3.3-7.0 GHz) or the mm-wave band (24-34 GHz). It consisted of two parabolic cylindrical reflectors and a set of small size broadband resonant feeds as shown in Fig. 1. The geometry and the dimensions of the sub-6GHz feed were published in [8].

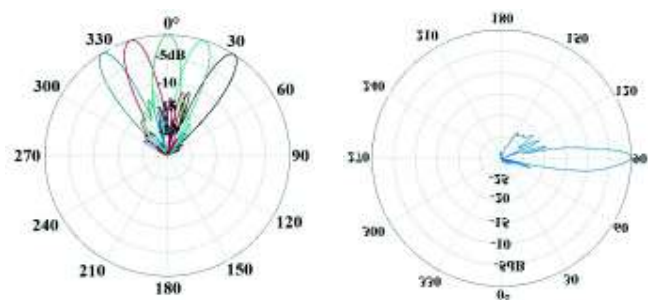
Multi-beam technology could be easily applied to the dual parabolic cylindrical reflector antenna by adding multi-feeds. For example, Fig. 1 (a) shows a penta beam antenna with a line

of five feeds aligned horizontally to generate five horizontal beams having the same elevation angle as shown in Fig. 2. These radiation patterns were calculated with a special software code using the geometrical theory of diffraction [9]. The accuracy of the software was experimentally verified several times [6], [7]. On the other hand, Fig. 3 shows a penta beam antenna with five feeds aligned to generate five beams with different elevation tilt angles.



(a) Multi-feeds for multi-beams (b) Covered with a gridded radome

Fig. 1 Base station antennas using dual parabolic cylindrical reflectors



(a) Azimuth (b) Elevation

Fig. 2 Radiation patterns of a penta beam antenna generating five beams having equal elevation angles

Four sub-6 GHz penta-beam antenna units were used as a switched-beam smart base station antenna. Each of these units produces five beams in each 90° azimuth main-sector [6], [7].

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With these four penta-beam units, 20 beams with 40 ports ($\pm 45^\circ$ polarizations) were generated to cover the whole azimuth plane (360°), as shown in Fig. 4. A sub-6GHz multi-beam antenna unit was manufactured by a 3D printer and then the reflecting portions/faces were covered by a very thin layer of aluminum foil/tape. The length/width of the main reflector were 80/56 cm. The length/width of the sub-reflector were 17/56 cm. The focal lengths of the main/sub reflectors were 40/20 cm. The overall weight of the multi-beam unit with the radome was around 2 kg. Thus, the overall weight of the four units was about 8 kg. The return loss of the antenna was always better than 14 dB over the whole frequency band (3.3-7.0 GHz) [7]. The azimuth radiation patterns of the antenna are shown in Fig. 4 (b). The gain of the manufactured configuration was ranging from 20 to 24 dBi and the front-to-back ratio at 180° was ≥ 30 dB. The first upper side lobe suppression was 15 dB and the isolation between polarizations was ≥ 20 dB. The isolation between beams was ≥ 21 dB. Moreover, each beam could be electrically tilted by an arbitrary elevation tilt angle.

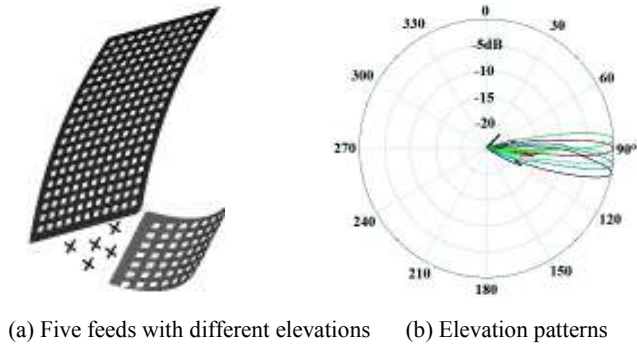


Fig. 3 A penta beam antenna generating five beams with different elevation angles

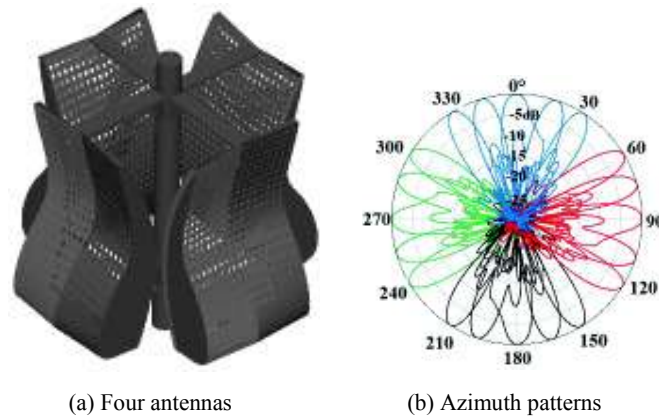


Fig. 4 Four penta beam antennas covering 360° generating 20 beams with 40 ports

The $\pm 45^\circ$ polarization feeds, in base station antennas, are used in spatial diversity MIMO, where the same data are sent to provide a more reliable link, or in spatial multiplexing MIMO, where independent data streams are sent to increase link capacity. A broadband resonant single port orthogonally polarized feed antenna has been used to considerably reduce the

need for spatial diversity MIMO. It is equally sensitive to two perpendicular polarizations ($\pm 45^\circ$) [10]. Thus, the two spatially separated $\pm 45^\circ$ polarization feeds can be replaced by an orthogonally polarized feed with a single port. On the other hand, the need for a spatial multiplexing MIMO may be significantly reduced in this multi-beam antenna because of its high capacity with its large number of beams and wide frequency bandwidth. However, base station transceivers have two ports for $\pm 45^\circ$ polarization diversity. With orthogonally polarized feeds, these two ports can be connected to two different beams above each other. Thus, the system will be equivalent to 4x4 diversity MIMO. RF power combiners/splitters can also be used to combine the multi beams into a single beam or any arbitrary number of beams/ports. The gain of the combined-beam will be more than 20-24 dBi instead of 17-18 dBi of conventional wide-beam antennas. Furthermore, the users will always be close to the peak gain value of the combined beam regardless of the angle of their location inside the beam. Of course, the combined beams must have the same frequency band.

II. REDUCING THE NEED FOR MIMO USING ORTHOGONALLY POLARIZED FEEDS

As mentioned above, the $\pm 45^\circ$ polarizations, in base station antennas, are used in spatial diversity MIMO and/or in spatial multiplexing MIMO. The need for a spatial multiplexing MIMO can be significantly reduced in this antenna because of its high capacity and wide frequency bandwidth. To considerably reduce the need for spatial diversity MIMO, a broadband resonant single port orthogonally polarized feed antenna has been developed to cover the 5G Sub-6GHz spectrum (3.3-7.0 GHz) or the mm-wave spectrum (24-34 GHz) [9]. It is equally sensitive to two perpendicular polarizations ($\pm 45^\circ$). Thus, the two spatially separated $\pm 45^\circ$ polarization feeds can be replaced by an orthogonally polarized feed with a single port. So, the number of ports becomes equal to the number of beams.

The detailed dimensions of the feed can be found in [10]. The arms of the developed orthogonally polarized feed antenna are bent by 90° where the location of the bending point is optimized such that the feed is equally sensitive to two perpendicular polarizations. The radiation patterns of the orthogonally polarized feed in the two vertical planes of the orthogonal arms (x-z and y-z planes) are shown in Fig. 5 at 4.0 GHz as a sample frequency. The radiation patterns in the two vertical planes of the two arms are very similar to each other. This indicates that the orthogonally polarized feed is equally sensitive to two perpendicular polarizations.

As an example, Fig. 6 shows the antenna with one row of 5G sub-6GHz (3.3-7.0 GHz) orthogonally polarized feeds. The total gain and its $\pm 45^\circ$ components of this penta beam configuration are shown in Fig. 7 at a sample frequency 4 GHz. It covers the whole azimuth with 20 beams and 20 ports instead of 40 ports. The total gain is ranging from 20 to 24 dBi. The $+45^\circ$ and -45° components are close to each other, where each of them is about half of the total gain (i.e., -3 dB).

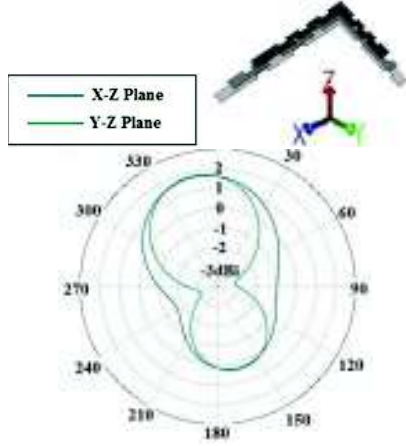


Fig. 5 Radiation Patterns of the orthogonally polarized antenna at 4.0 GHz

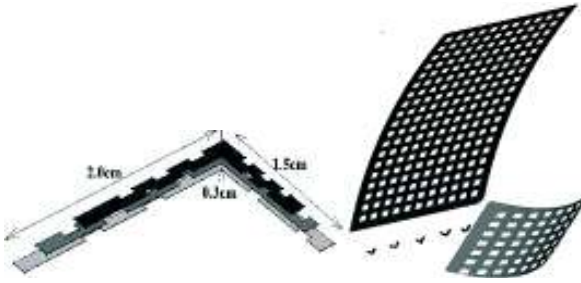


Fig. 6 An orthogonally polarized multi-beam dual parabolic cylindrical reflector antennas using orthogonally polarized feeds

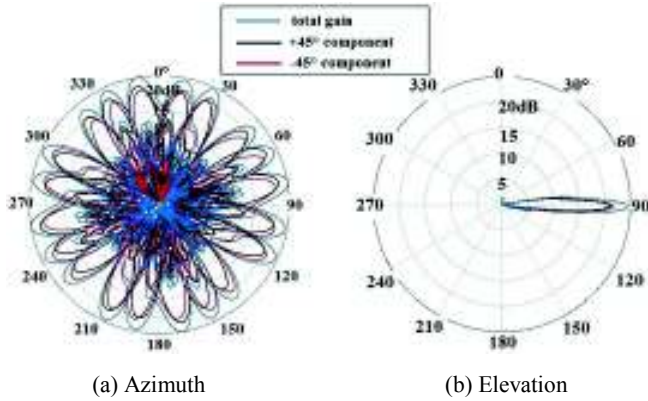


Fig. 7 Total gain and $\pm 45^\circ$ components - One row of feeds generating 20 beams with 20 ports at 4 GHz

III. A SIMPLE 4X4 MIMO CONFIGURATION USING ORTHOGONALLY POLARIZED FEEDS

Simultaneous vertical and horizontal sectorization can be achieved by using several rows of feeds [11]. For example, Fig. 8 shows the radiation patterns of two sets of beams with two rows of feeds. If orthogonally polarized feeds are used, the total number of ports will be equal to the number of beams. Hence, the number of ports will be 40 ports instead of 80. However, each of the current base station transceivers has two different ports for $\pm 45^\circ$ polarization diversity. Instead, these two ports can be used for space diversity MIMO where the $\pm 45^\circ$

polarization ports of the transceivers can be connected to two different beams above each other according to the configuration of Fig. 8. Thus, with only two-port transceivers, the system will be equivalent to 4x4 MIMO, instead of 2x2 MIMO, combining both polarization and space diversities.

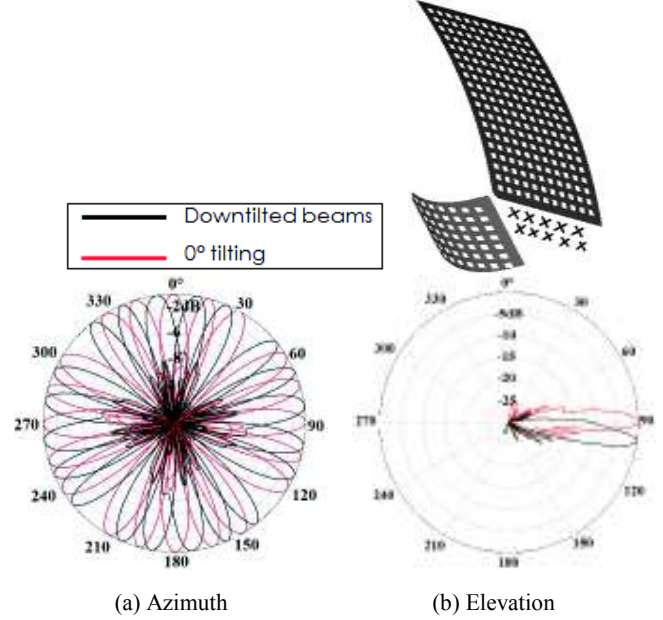


Fig. 8 Four penta beam units covering 360° with 40 beams at a sample frequency 4 GHz

IV. COMBINING SOME OF THE ADJACENT BEAMS AND PORTS USING COMBINERS/SPLITTERS

RF power combiners/splitters can be used to combine the ports and the beams of the multi-beam base station antenna into any arbitrary number of beams/ports [12]-[15]. So, the gain will be significantly increased over the whole beam angle without any modifications in the used transceivers. The gain of the combined-beams will be more than 20-24 dBi instead of 17-18 dBi of the conventional wide-beam antenna. Furthermore, the users will always be close to a peak gain value regardless of their location within the combined beam angle. Moreover, with the orthogonally polarized feeds, the configuration will be equivalent to 4x4 MIMO, instead of 2x2 MIMO, as explained above. It should be noted that the combined beams should have the same frequency band. For example, Fig. 9 shows a multi-beam antenna with two rows of feeds generating 10 beams. The horizontal feed locations are adjusted such that the peaks of the upper beams are above the nulls of the lower beams and vice versa, as shown in Fig. 8. The antenna will have a total of 20 ports because of the $\pm 45^\circ$ polarizations, where each polarization has ten ports, as shown in Fig. 9 (a). If orthogonally polarized feeds are used, the antenna will have two rows of feeds with a total of ten ports, which is equal to the number of beams, as shown in Fig. 9 (b). Each of these sets, which are five ports each, can be combined into a single port, as shown in Fig. 9 (c). This will result in an antenna with two ports that can be used with any of the existing conventional single beam base stations. The difference, as mentioned above, is that the gain

will be significantly increased over the whole beam-width of the combined beam. Furthermore, the users will always be close to a peak gain value regardless of the angle of their location inside the combined beam. On the other hand, different configurations of RF power splitter/combiners can be used to provide any arbitrary number of ports according to any special requirements. For example, each five ports can be combined into three ports as shown in Fig. 9 (d).

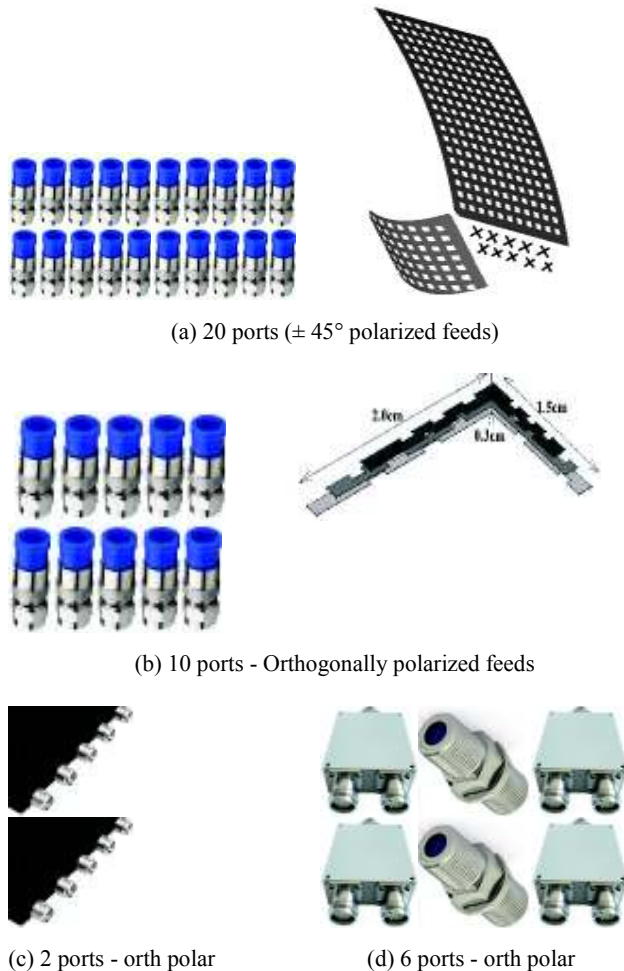


Fig. 9 Two rows of feeds generating 10 beams combined into different configurations of ports

V. CONCLUSION

A multi-beam base station antenna was developed. It could cover the whole sub-6GHz band (3.3-7.0 GHz) or the mm-wave band (24-34 GHz). It consisted of dual parabolic cylindrical reflectors. The developed multi-beam antenna had a high capacity because of its large number of beams and its wide frequency bandwidth. Hence, the need for the spatial multiplexing MIMO could be significantly reduced. To reduce the need for spatial diversity MIMO, a broadband resonant single port orthogonally polarized feed antenna was developed. It was equally sensitive to two perpendicular polarizations ($\pm 45^\circ$). Thus, the two spatially separated $\pm 45^\circ$ polarization feeds were replaced by an orthogonally polarized feed with a single

port. So, the number of ports became equal to the number of beams. The $+45^\circ$ and -45° components of the radiation patterns of the orthogonally polarized feed were close to each other, where each of them was about half of the total gain (i.e. -3 dB). However, the current base station transceivers have two different ports for $\pm 45^\circ$ polarization diversity. Instead, these two ports could be used for space diversity MIMO where two sets of beams were generated above each other. So, the $\pm 45^\circ$ polarization ports of the transceivers could be, alternatively, connected to two different beams above each other. Thus, with only two-port transceivers, the system was equivalent to 4x4 MIMO, instead of 2x2 MIMO, combining both polarization and space diversities. The space diversity was due to the separation between the feeds of the two beams which were above each other. The polarization diversity was due to the single-port orthogonally polarized feeds. On the other hand, RF power combiners/splitters could be used to combine the ports of the multi-beam base station antenna into any arbitrary number of beams/ports. This could result in an antenna with two ports that could be used with any of the existing conventional single beam base stations. The difference was that the gain of the combined-beam was more than 20-24 dBi instead of 17-18 dBi of conventional single wide-beam antennas. Moreover, the gain was increased over the whole beam-width and, hence, the users were always close to a peak gain value regardless of their location within the beam angle. Furthermore, the system was equivalent to 4x4 MIMO, instead of 2x2 MIMO, combining both polarization and space diversities. The space diversity was due to the separation between the feeds of the two beams which were above each other. The polarization diversity was due to the single-port orthogonally polarized feeds. The frequency bands of all the combined beams were adjusted such that, they all operated at the same frequency band. On the other hand, different configurations of RF power splitter/combiners could be used to provide any arbitrary number of ports according to any special requirements. For example, each five ports could be combined into three ports.

REFERENCES

- [1] A.K.M Fazlul Haque, Mir Mohammad Abu Kyum, Md. Baitul Al Sadi, Mrinal Kar and Md. Fokhray Hossain, "Performance Analysis of UMTS Cellular Network using Sectorization Based on Capacity and Coverage", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 2, No. 6, 2011,
- [2] L. Shen, H. Wang, E. Willis, W. Lotz, H. Jamali, "Compact Dual-Band Interleaved Multi-Beam Base Station Antenna", 2020 IEEE Symposium on Antennas and Propagation
- [3] D. Guan, C. Ding, Y. J. Guo, "A compact multi-beam antenna without beam forming network", 2016 International Symposium on Antennas and Propagation (ISAP)
- [4] W. Wu, Z. Zhang, Y. Zhao, Q. Liu, C. Wang, Y. Zuo, "Design of Multi-Beam Antenna Based on Rotman Lens", 2019 International Applied Computational Electromagnetics Society Symposium - China (ACES)
- [5] N. Herscovici, "A Highly Efficient, Multi-beam, Wide Scan Angle Antenna", 2020 IEEE International Symposium on Antennas and Propagation
- [6] M. Sanad and Noha Hassan, "A Multiple Beam LTE Base Station Antenna with Simultaneous Vertical and Horizontal Sectorization," International Journal of Electronics and Communication Engineering, Vol:12, No:1, PP.82-88, 2018.
- [7] M. Sanad and N. Hassan, "A 5G Sub-6GHz Switched-beam Smart Base Station Antenna with an Arbitrary Remote Electric Tilt for Each Beam",

- Microwave Journal, Online Spotlight article, Nov 2020, <https://www.microwavejournal.com/authors/4817-mohamed-sanad-and-noha-hassan-cairo-university-giza-egypt>
- [8] M.Sanad and Noha Hassan, "Orthogonally Polarized MIMO LTE/5G Terminal Antennas for Handsets and IoT Applications," 2019 IEEE Radio and Wireless Symposium (RWS2019), Orlando, FL, USA, January 2019.
 - [9] M.Sanad and L. Shafai, "Generation of Elliptical Beams of Arbitrary Beam Ellipticity and Low Cross-Polarization Using Offset Dual Parabolic Cylindrical Reflectors," Canadian Journal of Electrical Engineering, Vol.13, No.3, pp.99-105, 1988.
 - [10] M.Sanad and Noha Hassan, "A Single Port Orthogonally Polarized Antenna for Handsets, IoT Terminals and Vehicles," 2020 14th European Conference on Antennas and Propagation (EuCAP), Copenhagen, Denmark, March2020
 - [11] Salam Akoum, Joydeep Acharya and Amitav Mukherjee "Method of operating vertical sectorization in FD-MIMO systems," Patent application WO2015152931A1, 2015, Oct. 8, (Online). Available: <https://www.google.com/patents/WO2015152931A1?cl=en>
 - [12] A. Safarian, Le. Zhou, P. Heydari, "CMOS Distributed Active Power Combiners and Splitters for Multi-Antenna UWB Beamforming Transceivers" IEEE Journal of Solid-State Circuits, 2007, Volume: 42, Issue: 7
 - [13] G. Kim, J. Kim, S Chae, J. Yu, "A Reconfigurable Feeder for Combinational Switched-Beam Network", 2018 IEEE International Symposium on Antennas and Propagation
 - [14] K. J. Flattery, S. Amin. Y. Mahamat, A. Eroglu. D. Ronnow, "High power combiner/divider design for dual band RF power amplifiers", 2015 International Conference on Electromagnetics in Advanced Applications (ICEAA)
 - [15] F. Martiacuten, L. Zhu, J. Hong, F. Medina, "Balanced Power Dividers/Combiners", a book chapter of "Balanced Microwave Filters", Wiley-IEEE Press, 2018

Using Diethers as Internal Donor on MgCl₂-Supported Ziegler–Natta Catalyst in Propylene Polymerization

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Abstract— Ziegler–Natta (Z-N) catalyst has an immense effect on the development of polyolefin industry. Z-N catalysts using MgCl₂ as a support are still the most important systems for the production of polyolefins. In modern industry, 4th and 5th generation Z-N have an important role. These catalysts are commonly used in petrochemical industries, in particular polypropylene (PP) and polyethylene production.

The discovery of Diethers: 2,2-disubstituted-1,3-dimethoxypropane (1,3-diether), a novel and simplified generation of MgCl₂-supported catalysts had been developed. These substances have the property to generate highly active and stereospecific catalysts without as cooperation of any ED.

9,9-bis(methoxymethyl)fluorene (BMF), had been already announced and could remarkably improve the stereospecificity of Z-N catalyst and the other one is

1,1-bis(methoxymethyl) cyclobutene (CBB), which is an innovative donor used. A series of catalysts are prepared through changing the molar ratio between donor and MgCl₂ - in the processing of the catalyst preparation. The performances of catalysts, which include the composition, polymerization activity, and stereospecificity, are investigated

Diethyl malonate and trimethylene chlorobromide, TiCl₄ MgCl₂, and triethylaluminum were used without further purification.

The effect of the Diether/Mg molar ratio in the catalyst preparation process. At first ZN0 does not consist of any internal or external donor. Ti content on ZN0 catalyst without any electron donor reaches the highest of 7.89. We can easily see that increasing Diether/Mg molar ratio during the preparation of the catalyst, Ti content decreases and donor content increases. Increases in Ti and donor content on BMF-containing catalysts are becoming more drastic relative to those on CBB-containing catalysts. For example, Ti content on BMF3 catalyst drops to 4.92% from 7.89% and BMF content adds to 49.12% from 0 when the BMF/Mg molar ratio is 20/100; Ti content on CBB3 catalyst decreases to 6.98% from 7.89% and CBB content raises 16.21% when the CBB/Mg molar ratio is 20/100. The difference is due to the variety of donor structure.

Keywords— Ziegler -Natta catalyst, Internal donor, External donor, Polymerization,

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An Enhanced Support Vector Machine-Based Approach for Sentiment Classification of Arabic Tweets of Different Dialects

Gehad S. Kaseb, Mona F. Ahmed

Abstract—Arabic Sentiment Analysis (SA) is one of the most common research fields with many open areas. Few studies apply SA to Arabic dialects. This paper proposes different pre-processing steps and a modified methodology to improve the accuracy using normal Support Vector Machine (SVM) classification. The paper works on two datasets, Arabic Sentiment Tweets Dataset (ASTD) and Extended Arabic Tweets Sentiment Dataset (Extended-AATSD), which are publicly available for academic use. The results show that the classification accuracy approaches 86%.

Keywords—Arabic, classification, sentiment analysis, tweets.

I. INTRODUCTION

SA is the study of people's comments, and opinions on a selected object. Sentiment Classification (SC) approaches can be divided into three main categories: lexicon-based, machine learning (ML) and hybrid approaches. This paper uses a hybrid approach which aims to incorporate all ML and lexicon-based methods, so that it can take advantage of the benefits of each approach. SVM classifier is also used as it is considered one of the most effective classifiers in the SA field as indicated in the literature surveyed [1].

The proposed approach targets Arabic dialects. However, there is a lack of resources for Modern Standard Arabic (MSA) and even much worse in dialectal Arabic. Considering the importance of an emoji can significantly improve applications that study, analyze, and summarize electronic communications, rather than continuously removing emojis as a preprocessing step. The application of emoji SA is used to boost the sentiment rating.

The remainder of this paper is organized as follows: Section II explores SA related works. Section III illustrates the proposed SA methodology. Section IV shows the results and analysis. Section V presents concluding remarks and discusses the future work.

II. RELATED WORK

Some work done in Arabic SA utilized ML methods; others used a lexicon-based approach. Lexicon-based approaches are unsupervised approaches that depend on external lexica to classify sentiments. ML approaches are mainly supervised approaches that rely on the existence of labeled training

documents/phrases using classifiers such as SVM and naïve Bayesian. Hybrid approaches are those that combine lexicon and ML techniques. The interested reader is referred to the survey in [1].

ASTD is a corpus of tweets suggested by [2]. It is composed of 10,006 tweets written in MSA and Egyptian colloquial Arabic. The tweets are classified into 799 positive, 1,684 negative, 832 neutral and 6,691 objective tweets. Different ML approaches were used in this paper. The best recall achieved was 69% using SVM. However, this paper did not mention any pre-processing or cleaning steps. The dataset includes a small number of subjective tweets.

Extended-ATSD: Arabic Tweets Sentiment Dataset is a corpus of tweets proposed by [3] which consists of 7082 tweets written in MSA as well as Egyptian colloquial Arabic. It is composed of 714 positive tweets, 1901 negative tweets, 714 neutral tweets and 3530 objective tweets. The best accuracy achieved was 62.4%.

The SentiStrength software [4] is used to observe and measure the strength of the sentiment expressed within the social media text. It was originally developed for English and later was adapted to different languages including Arabic. Using SentiStrength, the approach proposed by [5] assigned a score to every tweet that indicates the entire sentiment score. They performed a comprehensive analysis of SentiStrength using 11 Arabic datasets consisting of tens of thousands of reviews/comments from different domains and in several dialects. They perform the analysis in terms of positive and negative sentiments. The evaluation results show that overall SentiStrength achieves 62% accuracy, 83.7% precision, 64% recall (positive correct), 68% F1 measure and 55% negative correct.

The authors in [7] presented NileULex, which is an Arabic sentiment lexicon containing approximately 6000 Arabic words and compound phrases. Egyptian or colloquial dialect is about 45% of the lexicon and MSA is about 55%. This lexicon took development period over two years. Whereas the gathering of many of the terms included in the lexicon was done automatically, the particular addition of any term was done manually. One of the vital criteria for adding terms to the lexicon was to disambiguate them as much as possible. The result is a lexicon with a far higher quality than any translated variant or automatically constructed one.

III. PROPOSED SA SYSTEM

This section outlines the methodology and resources

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employed in the proposed work, the used datasets, preprocessing, classification architectures, and the accuracy measurements used to evaluate them. The system components are described in detail in the following sections.

A. Used Datasets

For all the conducted experiments, two datasets are used which are available for academic use; ASTD [2] and Extended-ATSD [3].

ASTD and Extended-ATSD both have four labels: positive, negative, neutral and objective. Due to the highly skewed distribution of the classes, and since our focus is to perform opinion classification rather than subjectivity classification, we excluded the objective and neutral tweets. So, we focused on positive and negative tweets only. Then, the datasets will be preprocessed and cleaned by a series of proposed steps to improve the classification accuracy. Table I shows the used datasets statistics.

TABLE I
ASTD AND EXTENDED-ATSD USED DATASET POLARITIES

	ASTD	Extended-ATSD
Positive	798	714
Negative	1680	1901
Total	2478	2847

B. Preprocessing

In this phase, the data is prepared before being fed to the classifiers either in the training phase or in the testing phase. Preprocessing phase includes those sequential steps:

Step 1: Normalization

- Remove Taskeel: This Arabic list (Fathatan, Dammatan, Kasratan, Fatha, Damma, Kasra, Shadda, Sukun, Maddah above, Hamza above, Hamza below, Subscript Alef, Inverted Damma, Mark Noon Ghunna, Zwarakay, Vowel Sign Small V above, Vowel Sign Inverted Small V Above, Vowel Sign Dot below, Reversed Damma, Fatha with two dots, Wavy Hamza below, Letter Superscript Alef)
- Remove Tatweel: for example أنا will be انا.
- Remove honorific sign (Arabic Sign Sallallahou Alayhe Wa Sallam “صلي الله عليه وسلم”, Arabic Sign Alayhe Assallam “عليه السلام”, Arabic Sign Rahmatullah Alayhe “رحمه الله”, Arabic Sign Radi Allahou Anhu “رضي الله عنه”, Arabic Sign Takhallus)
- Remove koranic annotation list (Arabic Small High Tah, Arabic Small High Ligature Alef With Lam With Yeh, Arabic Small High Zain, Arabic Small Fatha, Arabic Small Damma, Arabic Small Kasra, Arabic Small High Ligature Sad With Lam With Alef Maksura, Arabic Small High Ligature Qaf With Lam With Alef Maksura, Arabic Small High Meem Initial Form, Arabic Small High Lam Alef, Arabic Small High Jeem, Arabic Small High Three Dots, Arabic Small High Seen, Arabic End Of Ayah, Arabic Start Of Rub El Hizb, Arabic Small High Rounded Zero, Arabic Small High Upright Rectangular Zero,

Arabic Small High Dotless Head Of Khah, Arabic Small High Meem Isolated Form, Arabic Small Low Seen, Arabic Small High Madda, Arabic Small Waw, Arabic Small Yeh, Arabic Small High Yeh, Arabic Small High Noon, Arabic Place Of Sajdah, Arabic Empty Centre Low Stop, Arabic Empty Centre High Stop, Arabic Rounded High Stop With Filled Centre, Arabic Small Low Meem)

- Normalize the letters which have more than one form such as Alef (replace the Alef with Hamza above “أ”, and Alef with Hamza below “إ” and Alef Madda “إ” to Alef “ا”), Haa (replace the Taa Marbuta “ة” with Haa “ه”) and Yaa (replace the Dotless Yaa “ي” with Yaa “ي”)

Step 2: Emoji Word Converter

Emoticons and emojis are extracted using the “emoji” java library [6], and then they are replaced with their Aliases using a manually-prepared list of emotion-word converter Table II. These words are then used in the emotion word lexicon.

TABLE II

EMOTION-WORD CONVERTER LIST

Emotion-Word	Emotion-Word
:(' = وجهيكاء	^_ = وجهيسعيد
:(" = وجهيكاء	-_- = وجهيسعيد
:< = وجهزعلان	^-^ = وجهيسعيد
3:) = وجهشيطان	*_* = وجهيسعيد
>-) = وجهشربير	:-) = وجهيسعيد
>:(= وجهغاضب	O:) = وجهملاك
^_^ = وجهيسعيد	:) = وجهيسعيد
:/ = وجهزعلان	:-@ = وجهغاضب
:O = وجهمدهش	((H)) = وجهمضن
: (= وجهحزين	:D = وجهضحك
:-(= وجهحزين	o.o = وجهمرتبك
O.o = وجهمرتبك	:* = وجهقلبه
o.O = وجهمرتبك	:P = وجهمتغاضب
<3 = وجهقلب	ISA = ان شاء الله
LOL = وجهضحك	Imo = برابي
Tyt = اهلا بعونتك	Jak = جزاك الله خيرا

Step 3: Arabic Named Entities Recognition

Named Entities Recognition (NER) becomes an important part of SA not only when the task is to identify an opinion holder but additionally for the task of determining semantic orientation. The reason for this is that the majority of Arabic first names, and to lesser extent family names, are derived from Arabic adjectives that can be easily confused for sentiments. Some Arabic male names that demonstrate this point include: Adel, Nabil, Said, and Hakim. The meanings of these names are: Just, Noble, Happy, and Wise. Examples of female names include: Gamila, Latifa, Sara, and Wafia, whose meanings are: Beautiful, Nice, Happy, and Loyal [8].

The Named Entities are removed after recognizing them by using gazetteer lists. We use ANERGazet [9] which is a collection of three Gazetteers. (i) Location Gazetteer: this dictionary consists of 1,950 continents names, countries, cities, rivers and mountains found in the Arabic version of Wikipedia. (ii) Person Gazetteer: this dictionary consists of 2,309 Arabic and non-Arabic names of people found in Wikipedia and other websites. (iii) Organizations Gazetteer:

which consists of a listing of 262 names of companies, football teams and other organizations from different web sources as well [10].

Step 4: Stop Words Removal

A manually-prepared stop words list was collected that consists of 5866 words starting from three Arabic stop words lists [11]-[13] then adding days and months names, country and capital names [14], and ANERGazet dictionaries then removing duplicates in these stop words.

Step 5: Misspelling Correction

Users sometimes repeat a character more than once to emphasize and stress their meaning. For example, the word “كثييير”, which implies “moooooe” in English, should be written as “كثير”; but the letter “ي” is continual.

The foremost word used is “هههههههههههه” which implies “hahahaha” for laughing so we detect first the hahaha word with any length then replace it with “ضحك” which implies “laugh”; we do that firstly because the next step will remove any other repetition. Secondly, deleting repeated characters is needed in order to have the base form of the words. However, some words already have repeated characters, such as “written” in English. To handle this matter, a Java program was used to delete repeated characters for words that are not in MSA.

Step 6: Other Cleaning

We remove punctuations (? ! . : | () - # / @ \$ ^ _ % & * + \ } { [] " ' ; , ' < >), symbols and other special characters.

C. Lexicons

Sentiment lexicons containing opinion terms, along with their polarity and strength are an essential part of any SA tool. There are currently limited publicly available colloquial Arabic sentiment lexicons. In order to have a good SA, sentiment scores of each tweet are calculated. These sentiment scores consist of positive score and negative score. Different lexicons were used:

- 1) A large-scale Arabic Sentiment Lexicon (ArSenL) was built by [15] and it is available for academic use. ArSenL is constructed using a combination of English SentiWordnet (ESWN), Arabic WordNet, and the Arabic Morphological Analyzer (AraMorph). This lexicon has sentiment for words in the MSA. ArSenL has more than 28 thousand lemmas with almost 158 thousand synsets, which means that each lemma may have a different part of speech, or different sentiment scores. Each line in this sentiment lexicon represents one word, with the lemma of the word analyzed using Aramorph analyzer, POS, positive score and negative score. The other information is disregarded in our use. It can also be seen that each lemma has two different scores which are positive score and negative score. Moreover, the words in the lexicon are represented using lemmas not Arabic characters. We use buckwalter to Unicode converter [16] to get the corresponding Arabic words. Fig. 1 shows a snapshot of

the Arabic words written in English of sentiment lexicon and Fig. 2 shows the corresponding Arabic words.

```
raHomap_1;n;0;0;50;NIL;01071411;NIL
raHomap_1;n;0.625;0;50;NIL;01227495;NIL
raHomap_1;n;0.5;0.125;50;NIL;04829282;NIL
raHomap_1;n;0;0.75;50;NIL;04829550;NIL
raHomap_1;n;0;0.5;50;NIL;07553741;NIL
raHomap_1;n;0.125;0.5;50;NIL;07554500;NIL
raHomap_1;n;0.125;0;50;NIL;14474435;NIL
```

Fig. 1 Snapshot of the English sentiment lexicon

```

1_رُخْمَة;n;0;0;50;NIL;01071411;NIL
1_رُخْمَة;n;0.625;0;50;NIL;01227495;NIL
1_رُخْمَة;n;0.5;0.125;50;NIL;04829282;NIL
1_رُخْمَة;n;0;0.75;50;NIL;04829550;NIL
1_رُخْمَة;n;0;0.5;50;NIL;07553741;NIL
1_رُخْمَة;n;0.125;0.5;50;NIL;07554500;NIL
1_رُخْمَة;n;0.125;0;50;NIL;14474435;NIL

```

Fig. 2 Snapshot of the Arabic sentiment lexicon

More complexities would arise from the presence of dialectal words, idioms and compound phrases. So, dictionaries are needed for all these words categories.

- 2) Nile University's Arabic sentiment Lexicon NilULex v0.27 was proposed by [7]. It contains about six thousand Egyptian Arabic and MSA sentiment words and their polarities. The class distribution within this lexicon is shown in Fig. 3.

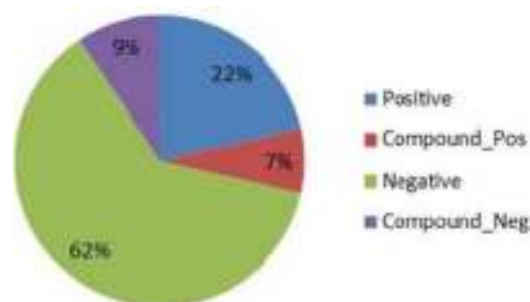


Fig. 3 NilULex Class distribution

- 3) Large multi-domain lexicons for SA in Arabic were proposed by [17]. The resources are publicly available in [18]. The authors showed that the generated lexicons are effective and reliable for Arabic SA. The combined lexicon (ALL_lex.csv) includes hotel, library, movie, production and restaurant opinion words with their polarity. The lexicons are domain specific lexicons, semi automatically generated from the datasets with total size of two thousand.
- 4) An Emoji lexicon was proposed by [19]. It contains emoji Unicode with its positive, negative and neutral score as shown in Fig. 4.

Emoji Sentiment Ranking v1.0

Char	Image [tweemoji]	Unicode codepoint	Occurrences [5...max]	Position [0...1]	Neg [0...1]	Neut [0...1]	Pos [0...1]	Sentiment score [-1...+1]	Sentiment bar (c.i. 95%)	Unicode name	Unicode block
😊		0x1f602	14622	0.805	0.247	0.285	0.468	0.221		FACE WITH TEARS OF JOY	Emoticons
❤️		0x2764	8050	0.747	0.044	0.166	0.790	0.746		HEAVY BLACK HEART	Dingbats
♥️		0x2665	7144	0.754	0.035	0.272	0.693	0.657		BLACK HEART SUIT	Miscellaneous Symbols
😍		0x1f60d	6359	0.765	0.052	0.219	0.729	0.678		SMILING FACE WITH HEART-SHAPED EYES	Emoticons
😭		0x1f62d	5526	0.803	0.436	0.220	0.343	-0.093		LOUDLY CRYING FACE	Emoticons
😘		0x1f618	3648	0.854	0.053	0.193	0.754	0.701		FACE THROWING A KISS	Emoticons
😊		0x1f60a	3186	0.813	0.060	0.237	0.704	0.644		SMILING FACE WITH SMILING EYES	Emoticons

Fig. 4 Emoji lexicon

- 5) An Emoticons lexicon was also manually built depending on the emotions words converted in step 2 in the preprocessing phase. Table III shows 16 words corresponding to the converted emoticons with their positive-negative annotation value; positive annotation takes value equal 1 and negative annotation takes value equal -1.

TABLE III
EMOTION WORD AND POS-NEG VALUE CONVERTER LIST

Word-value	Word-Value
1 وجه سعيد	1 وجه مملوك
1- وجه حزين	1- وجه بكاء
1- وجه شيطان	1 وجه حزن
1- وجه شرير	1- وجه علان
1- وجه غاضب	1 وجه ضحك
1- وجه متبك	1 وجه مندھش
1- وجه متغاط	1 وجه قبله
1 وجه قلب	1 ضحك

There are Arabic words that do not exist in the lexicons. In this case, these words will be disregarded, which means the sentiment scores are calculated using only the words that exist in the lexicons. The final dataset after adding lexicon features will be represented by six features e.g. (Arabic Tweet, annotated sentiment, 0,0,0,0,0,0). The six features are representing positive and negative scores for ArSenL, NileUnv and Emoticons lexicon, respectively.

D. Classification

From the study, comparison and analysis of the different proposed methodologies for SA, it was observed that SVM yield the best performance [1]. So, SVM with TF-IDF feature vector was used.

E. Evaluation Measures

We report the results of each experiment using accuracy metric to measure the performance. Accuracy reports the ratio of correctly classified tweets to the total number of tweets regardless of their class.

IV. RESULTS AND ANALYSIS

We run the algorithm 100 times using a random seed to shuffle and partition the dataset into training set (80%) and test set (20%). This randomness changes the training and test sets in every iteration, which means that the methodologies are tested using 100 combinations of the training and test sets. The three values, Max., Avg. and Min. shown in Table IV which represents the maximum, average and minimum accuracy achieved over the 100 iterations.

TABLE IV
ACCURACY RESULTS FOR BOTH DATASETS ASTD AND EXTENDED-ASTD

	ASTD	Extended-ASTD
Max	86.0	85.9
Avg.	79.4	79.1
Min	75.6	72.1

The authors in [20] extracted a subset of the ASTD dataset with the positive and negative tweets only. They reached accuracy: 57.1%, Precision: 38.5% Recall: 55.7% and F1: (45.5%).

The authors in [21] extracted a subset of the ASTD dataset with the positive and negative and neutral tweets. These data are split into a training set (70%), a development set (10%) and a test set (20%). The results show that RNTN achieves the best performance (Accuracy = 58.5% and Average F1 = 53.6%) although it was trained on a dataset that is different from that used for testing.

The authors in [22] extracted a subset of the ASTD dataset with the positive and negative tweets only. The resultant accuracy reaches 75.9% when the model has been trained in a balanced form and 79.07% in an unbalanced form.

The authors in [23] extracted a subset of the ASTD dataset with the positive and negative tweets only. They then combined it with ArTwitter [24], and QCRI [25]. They achieved recall: 76.5%, precision: 83.0%, F-measure 79.62% and macro-accuracy: 80.21%.

V. CONCLUSION

This work presented a model for Arabic SA including the

preprocessing steps, the methodology and the used lexicons. The model was trained and tested using two datasets, ASTD and Extended-ATSD. The results show improved accuracy which achieved 86%. The intended future work is to create a large scale lexicon and to propose a deep learning model to enhance Arabic SA. In addition, it is planned to build Arabic SA software which annotates Arabic tweets online.

REFERENCES

- [1] Gehad S. Kaseb, Mona F. Ahmed. Arabic Sentiment Analysis approaches: An analytical survey. *International Journal of Scientific & Engineering Research*, Volume 7, Issue 10, October-2016 712 ISSN 2229-5518.
- [2] Mahmoud Nabil, Mohamed Aly and Amir F. Atiya. ASTD: Arabic Sentiment Tweets Dataset. *Proceedings of the 2015 Conference on Empirical Methods in Natural Language Processing*, pages 2515–2519, Lisbon, Portugal, 17-21 September 2015.
- [3] Kaseb, Gehad S., and Mona F. Ahmed. "Extended-ATSD: Arabic Tweets Sentiment Dataset" *Journal of Engineering and Applied Sciences* 14.14 (2019): 4780-4785.
- [4] M. Thelwall, Heart and soul: sentiment strength detection in the social web with sentistrength, in: *Proceedings of the CyberEmotions*, 2013, pp. 1–14.
- [5] A. Rabab'ah, M. Al-Ayyoub, Y. Jararweh, M. Al-Kabi, Evaluating sentistrength for Arabic sentiment analysis, in: *2016 7th International Conference on Computer Science and Information Technology (CSIT)*, 2016, pp. 1–6.
- [6] Vdurmont. 2016. The missing emoji library for java. <https://github.com/vdurmont/emoji-java>.
- [7] El-Beltagy, Samhaa R., 2016. NileULex: A Phrase and Word Level Sentiment Lexicon for Egyptian and Modern Standard Arabic. In *proceedings of LREC 2016*, Portorož, Slovenia.
- [8] Open Issues in the Sentiment Analysis of Arabic Social Media: A Case Study, Samhaa R. El-Beltagy
- [9] ANERGazet available at: <http://users.dsic.upv.es/grupos/nle/?file=kop4.php>
- [10] Benajiba, Y., Rosso, P., Bened'ı Ru'ız: ANERsys: An Arabic Named Entity Recognition System Based on Maximum Entropy. In: *Proceeding of CICLing-2007*, Mexico. *Lecture Notes in Computer Science* 4394, Springer-Verlag
- [11] Arabic Stop Words list available at: https://www.arabeyes.org/%D9%85%D8%B3%D8%AA%D8%A8%D8%B9%D8%AF%D8%A7%D8%AA_%D8%A7%D9%84%D9%81%D9%87%D8%B1%D8%B3%D8%A9
- [12] Arabic Stop Words list available at: https://sites.google.com/site/kevinbouge/stopwords-lists/stopwords_ar.txt?attredirects=0&d=1
- [13] Arabic stop words list available at: <http://www.ranks.nl/stopwords/arabic>
- [14] Arabic country and capital names available at: http://www.nationsonline.org/oneworld/countrynames_arabic.htm
- [15] Gilbert Badaro, Ramy Baly, Hazem Hajj, Nizar Habash, and Wassim El-Hajj. A large scale arabic sentiment lexicon for arabic opinion mining. *ANLP 2014*, page 165, 2014.
- [16] Buckwalter to Unicode converter available at: <http://www.comp.leeds.ac.uk/andyr/software/>
- [17] ElSahar, Hady, and Samhaa R. El-Beltagy. "Building large arabic multi-domain resources for sentiment analysis." *International Conference on Intelligent Text Processing and Computational Linguistics*. Springer International Publishing, 2015.
- [18] Lexicons github website: <https://github.com/hadyelsahar/large-arabicsentiment-analysis-resouces-last>
- [19] Petra Kralj Novak, Jasmina Smailovic, Borut Sluban, ´ and Igor Mozetic. 2015. Sentiment of emojis. *PloS one*, 10(12):e0144296.
- [20] A. Rabab'ah, M. Al-Ayyoub, Y. Jararweh, M. Al-Kabi, Evaluating sentistrength for Arabic sentiment analysis, in: *2016 7th International Conference on Computer Science and Information Technology (CSIT)*, 2016, pp. 1–6.
- [21] Baly, Ramy, et al. "A Characterization Study of Arabic Twitter Data with a Benchmarking for State-of-the-Art Opinion Mining Models." *WANLP 2017 (co-located with EACL 2017)* (2017): 110.
- [22] Dahou, Abdelghani, et al. "Word Embeddings and Convolutional Neural Network for Arabic Sentiment Classification."
- [23] Altowayan, A. Aziz, and Lixin Tao. "Word embeddings for Arabic sentiment analysis." *Big Data (Big Data)*, 2016 IEEE International Conference on. IEEE, 2016.
- [24] N. A. Abdulla, N. A. Ahmed, M. A. Shehab, and M. AlAyyoub, "Arabic sentiment analysis: Lexicon-based and corpus-based," in *Applied Electrical Engineering and Computing Technologies (AEECT)*, 2013 IEEE Jordan Conference on, Dec 2013, pp. 1–6.
- [25] A. Mourad and K. Darwish, "Subjectivity and sentiment analysis of modern standard arabic and arabic microblogs," in *Proceedings of the 4th workshop on computational approaches to subjectivity, sentiment and social media analysis*, 2013, pp. 55–64.

The Impact of the Corona Virus Outbreak Crisis on Startups

Mohammad Mehdizadeh, Sara Miri

Abstract— Due to the recent events surrounding the global health crisis and the spread of the coronavirus (COVID-19), the activities of many businesses and start-up companies have been disrupted. It solves many economic problems and can reduce unemployment in countries because governments can take advantage of their potential without direct investment. However, with the help of their innovative ideas and new technologies, these companies can develop and grow the economy. But it is essential to consider that there will be no guarantee of their success in the event of unforeseen events, as the coronavirus outbreak in the last two years has seriously damaged these companies and, like other businesses, challenges and stagnation have started. The startup companies' challenge in the face of coronavirus begins with its impact on customers. Changing customer behavior can affect their products and distribution channels. On the other hand, to prevent countless losses in this crisis, startup companies require creative solutions to address challenges in various areas of human capital, supply chain management, sales and marketing, and so on. Therefore, all business leaders must consider and plan for the current crisis and the future; after overcoming these conditions and returning to regular business routines, it will no longer be an option, and new situations will prevail in a competitive environment. The essential strategies for developing and growing startups during the Coronavirus outbreak can be connecting with the global startup ecosystem, hosting webinars, providing podcasts and free question and answer sessions, mentoring services to growing teams, and consulting pointed out this to firms for digitalization.

Keywords— business, COVID-19, digitalization, startups.

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Establishment Of Virtual Fracture Clinic In Princess Royal Hospital Telford ; Progress And Recommendations During The First 9 Months

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Introduction

Virtual fracture clinics (VFC) have been shown to be a safe and cost-effective way of managing outpatient referrals to the orthopaedic department. During the coronavirus pandemic there has been a push to reduce unnecessary patient contact whilst maintaining patient safety.

Materials and Methods

A protocol was developed by the clinical team in collaboration with Advanced Physiotherapy Practitioners (APP) on how to manage common musculoskeletal presentations to A&E prior to COVID as part of routine service development. Patients broadly triaged into 4 categories; discharge with advice, referral to VFC, referral to face to face clinic or discussion with on call team. The first 9 months of data were analysed to assess types of injury seen and outcomes.

Results

In total 2489 patients were referred to VFC from internal and external sources. 734 patients were discharged without follow-up and 182 patients were discharged for physiotherapy review. Only 3 patients required admission. Regarding follow-ups, 431 patients had a virtual follow-up while 1036 of patients required further face to face follow up. 87 patients were triaged into subspecialty clinics. 37 patients were felt to have been referred inappropriately.

Discussion

BOA guidelines suggest all patients need to be reviewed within 72 hours of their orthopaedic injury. Implementation of a VFC allows this target to be achieved and at the same time reduce patient contact. Almost half the patients were discharged following VFC review, the remaining patients were appropriately followed up. This is especially relevant in the current pandemic where reducing unnecessary trips to hospital will benefit the patient as well as make the most of the resources available.

Key words: Virtual Fracture Clinic, Trauma and Orthopaedics, Covid-19

References:

- 1) Logishetty K, Subramanyam S Adopting and sustaining a Virtual Fracture Clinic model in the District Hospital setting – a quality improvement approach BMJ Quality Improvement Reports 2017;6:u220211.w7861. doi: 10.1136/bmjquality.u220211.w7861
- 2) BOAST guidelines: fracture clinic services, August 2013. <https://www.boa.ac.uk/uploads/assets/7ded8f00-987e-42d5-a389e739b1e03b47/ec9d4564-4fa7-4d08-aef4efc3cede7d53/fracture%20clinic%20services.pdf>
- 3) An analysis of virtual fracture clinics in orthopaedic trauma in the UK during the coronavirus crisis John-Henry Rhind, Eamon Ramhamadany, Ruairaidh Collins, Siddharth Govilkar, Debashis Dass, and Stuart Hay EFORT Open Reviews 2020 5:7, 442-448
- 4) Little M, Huntley D, Morris J, Jozsa F, Hardman J, Anakwe RE. The virtual fracture clinic improves quality of care for patients with hand and wrist injuries: an assessment of 3709 patients. J Hand Surg Eur Vol. 2020 Sep;45(7):748-753. doi: 10.1177/1753193420930610. Epub 2020 Jun 15. PMID: 32539577.
- 5) Bhattacharyya R, Jayaram PR, Holliday R, Jenkins P, Anthony I, Rymaszewski L. The virtual fracture clinic: Reducing unnecessary review of clavicle fractures. Injury. 2017 Mar;48(3):720-723. doi: 10.1016/j.injury.2017.01.041. Epub 2017 Jan 27. PMID: 28168971.
- 6) Moloney D, Feeley I, Hughes A, Clesham K, Kiernan C, Niall D. The surge in tele-orthopaedics in the setting of COVID-19, 13 April 2020. <https://www.boa.ac.uk/policy-engagement/journal-of-trauma-orthopaedics/journal-of-trauma-orthopaedics-and-coronavirus/the-surge-in-tele-orthopaedics-in-the-setting-of.html>

This study received ethics committee approval or was conducted under the Animal (Scientific Procedures) Act (1986) (include licence numbers) or equivalent

A Framework for Railway Passenger Station Site Selection Using Transit-Oriented Development and Urban Regeneration Approaches

M. Taghavi Zavareh, H. Saremi

Abstract

Railway transportation is one of the types of transportation systems which, due to the advantages such as the ability to transport a large number of passengers, environmental protection, low energy consumption, and contribution to tourism, has importance. The existence of suitable and accessible stations is one of the requirements that leads to better performance and plays a significant role in the economic, social, political, and cultural development of urban areas. This paper aims to propose a framework for locating railway passenger stations. This research used descriptive-analytical methods and library tools to answer which definitions and theoretical approaches are suitable for the location of railway passenger stations. The results showed that theoretical approaches such as Transit-Oriented Development and Urban Regeneration are of the utmost importance theoretical bases in the field of research. Moreover, we studied three stations in Iran to find out about real trends and criteria in this research. This study also proposed four major criteria including accessibility, development, rail related and economics, and environmental harmony. Ultimately with an emphasis on the proposed criteria, the study concludes that the combination of Transit-Oriented Development and Urban Regeneration is the most suitable framework to locate railway passenger stations.

Key Words: railway passenger station, railway station, site selection, transit-oriented development, urban regeneration.

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1. Introduction

Rail transport is considered one of the safest and most efficient ways to expand connections in different communities. In general, this system can connect social, economic, military, agricultural, and cultural hubs and move the largest number of people and goods with high reliability [Bakhtiari, 2016]. Railway, as one of the most important transportation modes, not only plays an important role in infrastructure networks but also has a great impact on the residential structure [Soltaniehha et al., 2016]. Currently, the rail transport industry has attracted the attention of most developed countries for reasons such as low fares, the provision of an integrated service system, low pollution, and significant transport capacity along with low energy consumption [Shaad et al., 2015]. In particular, stations as a railway junction with other industries means of Transport Systems, and land-uses plays a key role in railways.

In recent years, regarding urban development, especially in developing countries, studies have been conducted on the location of urban and intercity train stations. Most of the studies in the field of railway location are mainly focused on the design of the route and less attention has been paid to the location of its stations. However, in the following several decision-making methods have been proposed for different site-selection applications.

Farkas (2009) for locating urban train stations, considered five criteria including engineering and geological features, environmental suitability, population density, costs of the project, and connection index (between urban train network and other transportation systems, current centers, and potential travel absorber). Mohajeri and Amin (2010) in an article entitled "Railway station site selection using analytical hierarchy process and data envelopment analysis", used the AHP method to locate the railway station in Mashhad in Iran. In this research, 4 categories of criteria have been used for location: 1. Rail related, 2. passenger services, 3. architecture and urbanism, and 4. Economics. Liu and et al (2010) in an article entitled "A Comprehensive Evaluation Method of Adding Passenger Stations in Existing Intercity Railway Line" assesses alternatives based on five criteria as follows: (a) Local economic development degree. (b) Coordination degree between alternative and city planning. (c) Traffic connection degree between alternative and city. (d) Layout coordination degree between alternative and existing stations. (e) Construction cost. Yu and et al (2011) in an article entitled "Locating Urban Transit Hubs: Multicriteria Model and Case Study in China" considered 6 factors for the planning of urban transit hub locations including (1) overall

efficiency of the transit network, (2) transfer intensity in the transit network, (3) proximity to major passenger generators/attractors, (4) effectiveness of hub service coverage, (5) compatibility with land-use restrictions, and (6) adaptability to future developable transit concepts. previous studies show that there is a vast difference among criteria in locating railway stations. Although due to geographical differences, the location criteria of each station may be slightly different, it seems necessary to develop the correct and common criteria derived from scientific approaches and concepts. Thus, this paper aims to propose a framework consists of Transit-Oriented Development (TOD) and Urban Regeneration, which are known as relevant approaches for railway passenger station site selection. Since one of the important factors in the development of rail transport is the correct and principled location of railway stations, two paper questions are proposed:

- 1) Which approaches and concepts are the most important theoretical foundations to choose the optimal location of railway passenger stations?
- 2) What are the site selection criteria for railway passenger stations?

To answer these questions, this paper intends to provide a scientific understanding of concepts, factors, and processes affecting the site selection of railway passenger stations. In the following, the concepts, definitions, and theoretical approaches effective in locating stations will be explained.

2. Methodology

This paper is a study aimed at proposing a reliable theoretical framework for locating railway passenger stations in different geographical areas. To answer the question of which definitions, theoretical approaches, and indexing systems are suitable for developing criteria to locate railway passenger stations, descriptive-analytical methods and library tools have been used. Therefore, the methodology includes reviewing previous studies and documentary data to investigate effective approaches in developing the theoretical framework. It is worth mentioning that the criteria developed in this research can be localized based on feasibility, operationalization, data access, and conditions of the region.

3. Literature review

3.1. Transit-Oriented Development Approach (TOD)

Development with a focus on public transportation is a model of urban development based on public transportation that is formed around transportation centers and stations such as bus terminals, railway stations, subways, etc (Fig.1). the development is based on public transportation by creating urban centers with the feature of access to public transportation or development of existing urban centers for the smart growth of cities, urban development, and efficient spatial development. This development also focuses on residential and commercial areas to maximize access to public transportation [Loo et al., 2010]. The lists of some of the most important primary definitions of the Transit-Oriented Development Approach are documented in Table 1.

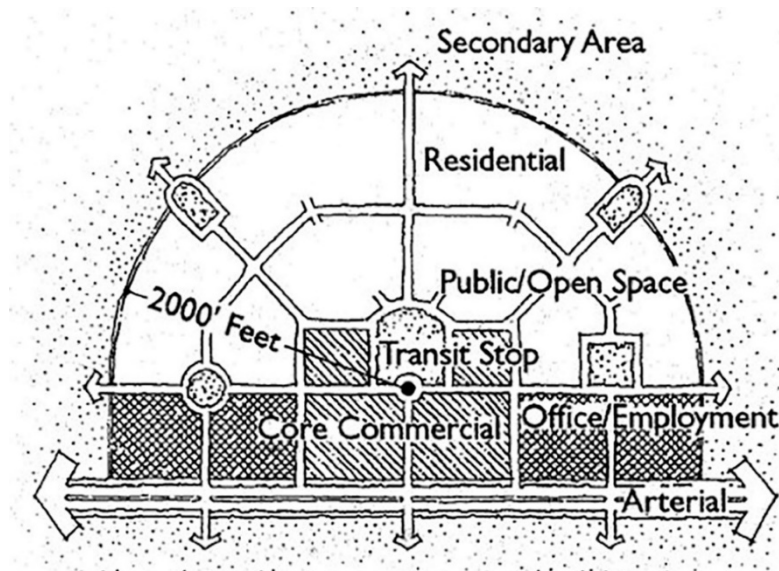


Fig. 1. The proposed scope of Transit-Oriented Development

Table 1: Some important and primary definitions of the TOD approach

Year	point of view	definitions
1993	Peter Calthorpe	Transit-Oriented Development is a dense center of residential, commercial, office, and public uses and open spaces in which retail and service shops in a commercial core with easy access (about 600 meters) They are located relative to the houses, and a public transport station is located in the core of this center.

1997	Bernick and Cervero	A collection with mixed and centralized uses around the transport station that with the right design, encourages residents, employees, and buyers to reduce the use of private cars and utilize more public transport.
1998	Porter	TOD is an attempt to control and manage the negative environmental impacts of sparse and low-density development patterns in American cities.
2000	Glendening	A relatively high-density location that combines a variety of residential, office, commercial and service uses within an easy walking distance of the rail and bus station, giving priority to pedestrians and cyclists.
2001	Arrington and Parker	A medium to high-density development located within easy walking distance of the main transport station and designed with a combination of residential, office, and commercial uses for pedestrians who do not use a private car. A TOD can be the new construction or redevelopment of one or more buildings whose design and location facilitate the use of transportation.

Railways as one of the most efficient public transportation systems can play a significant role in attracting passengers. Therefore, by increasing the efficiency of railway stations through creating welfare facilities and services such as shops, hotels, and services to facilitate the affairs of passengers, railway stations can be considered as one of the attractions of urbanization and centers of Transit-Oriented Development [Dittmar and Ohland, 2012; Niles and Nelson, 1999].

Hauptbahnhof Station in London is a successful example of applying the Transit-Oriented Development for locating and developing railway stations (Fig. 2). After the destruction of the Berlin Wall (1989), urban planners began working on a transport plan for the "United Berlin". In this plan, it was decided to build a new north-south railway line. In 1992, the federal government decided to build a new station near the center of Berlin and government buildings. Thus, the Hauptbahnhof station was built at the intersection of the two-railway northern and southern corridors of Berlin and the Western and Eastern junction of Berlin. Hauptbahnhof Station in Berlin is the largest station in Europe in terms of architectural structure, opening in

2006. In this station, 1800 trains run per day and service more than 350000 passengers daily [Peters, D, 2009]. The connection of this station with other modes of transportation systems can be understood in the image below. This example demonstrates a practical project of the need to create sustainable transport networks based on Transit-Oriented Development and multi-modality. Other traits of this station include easy and high quality of access to public transportations, proximity to urban functions, and servicing a large number of passengers [Peters and Novy, 2012].



Fig. 2. Hauptbahnhof Berlin Multimodality

3.1.1. General policies and principles based on Transit-Oriented Development

- Organization of city centers
- Controlling the growth of cities in the suburbs
- Increasing the density of housing and employment in the vicinity of public transport stations
- Increasing the quality of access to different modes of public transportation, and parking management
- Increasing diversity in land-uses in the vicinity of public transport stations
- increasing the odds for being multi-modality centers for stations

- Functional and physical connections to transport systems
- Increasing the attractiveness of pavements in the vicinity of public transport stations
- Design and create a network of green and open public spaces in the vicinity of public transport stations [Abbaszadegan and et al, 2011] [Niles and Nelson, 1999].

3.1.2. The role of railway stations in Transit-Oriented Development

The means of public transportation systems together should provide conditions such as safety and comfort for the movement of passengers. The use of different systems also needs to be economically justifiable. A mode of transportation must be in its proper place and function properly in its area of responsibility to optimize the efficiency of the entire system. The use of rail transportation systems, taking into account the different capacities of a city, is one of the factors that improve the productivity and integrity of the entire urban system.

In general, the centers that are considered for the Transit-Oriented Development, play a crucial role in the success of these projects. considering the various definitions of TOD centers, it can be seen that each of the definitions has given more weight to a part of the features of these centers; but, the common concepts visible in all definitions can be limited to the following four general points:

- Diversity and mixing of land uses.
- Proximity to advanced public transport stations such as subway and Light Rail Transit (LRT).
- Heeding attention to pedestrians and public transport passengers.
- High density [Mohajeri and Amin, 2010]. Dimensions and implementation policies of Transit-Oriented development are documented In Table 2.

Table 2: Dimensions and implementation policies of Transit-Oriented Development approach for locating railway passenger stations.

Development strategies	implementation policies/criteria	
Having the highest level of accessibility to public transport with the center of the main transport station	accessibility	accessibility between the station and other modes of transport
Mixed and centralized land uses around the transport station		accessibility to main streets and parking development

Increasing the density and quality of access in the vicinity of the station		pedestrian access between station and other modes of transportation
Station interaction with the city and public transport improvement	development	Locating of stations in the vicinity of developable urban areas
Controlling the growth of the city in the suburbs and organizing the city center		Locating of stations in areas with higher land-use density
Reducing the use of private cars and easy access to public transport centers and stations	environmental harmony	Preserving natural habitats and preventing the destruction of the natural environments
Controlling and managing environmental impacts		

[Calthorpe, 1993], [Bernick and Cervero, 1997], [Porter, 1998], [Maryland Department of Transportation, 2000], [California Department of Transportation, 2001], [Mohajeri and Amin, 2010], [Abbaszadegan and et al, 2011].

3.2. Urban regeneration Approach

The word "Regeneration" comes from the root "Regenerate" meaning: to revive and grow again. It also means the natural reproduction of a part of a living being that is in danger of being destroyed [Roberts and Sykes, 2000]. This term became widely used after 1995 as an alternative to urban renewal in the field of urban planning literature. Urban regeneration goes far beyond the ideals and achievements of urban renewal and fundamental physical changes [Couch, 1990]. The seven principles of urban regeneration include the following:

- 1) Improving the diversity of land uses: A city center should be equipped with recreational-commercial centers that attract people. Balancing the proper functioning of these centers should be done according to pedestrian traffic patterns.
- 2) Encouraging compression: Urban centers must be highly compact to maintain pedestrian mobility and economic and infrastructural convergence.
- 3) Creating development density: Considering a mixed land-use to locate urban functions. Development on Brownfield is also recommended as urban lands that were previously the

matter of construction but are now abandoned. This is an effective strategy to strengthen the user system without weakening the human scale of the city.

4) Balance of activities: Major uses and special areas are characteristic of cities that take the opportunity to play a more effective role in urban regeneration. In this regard, issues such as preventing the destruction of urban spaces and natural open spaces, preserving water resources and wetlands are considered [Cowan, 2005].

5) Improving accessibility: A defined traffic pattern consisting of an environment for the needs of pedestrians, accessibility to private cars and public transportation systems, and making a proper connection of urban passages.

6) Creating a functional connection: Pedestrian traffic through direct connecting routes creates an integrated network that connects downtown activities and their neighborhoods. On the other hand, reducing the number of urban travel and creating the best conditions for public transportation should also be considered.

7) Building an identity system: Identity is necessary to create a place for social interaction, Marketing, cultural activities, festivals and celebrations, and security which can all affect livability. Table 3 lists seven basic principles of urban regeneration.

Table 3: Principles of urban regeneration

1) Improving the diversity of land uses	Absorbing people with the help of different uses - the balance of functions and connections with infrastructure
2) Encouraging compression	capability to access activities - eliminate physical distancing - Economic convergence
3) Creating development density	flagship projects - zoning - endogenous construction
4) Balance of activities	Activity balance - attractive land uses
5) Improving accessibility	Providing easy access to vehicles and parking spaces - Proper movement pattern - Underground parking
6) Creating a functional connection	Traffic flow through direct communication route - Communication with city centers - Prohibition of constructing large parts - Intra-block route
7) Building an identity system	A place for social communication - cultural and commercial activities - safe living environment

[Paumier, 2004].

3.2.1. The need to pay attention to railway stations in urban regeneration

Railway stations, as the entry point of any city or country, are considered long-term projects with high durability. The basis of planning railway stations is to pay attention to their role in the city and the region, which can be at the national level as a regional and metropolitan use, or as an urban use. All in all, the most important reasons for considering railway stations can be classified into the following three cases:

- Railway station buildings are considered parts of the contemporary cultural heritage in many countries around the world.
- The key position of most railway stations as a Flagship of urban development.
- Existence of development opportunities at and around railway stations [Ataran, 2016].

A successful example of the connection between urban regeneration and railway stations can be found in Madrid, the capital of Spain. Chamartin station, which is located in the north of Madrid, is the central part of urban regeneration in northern Madrid. also, establishing a constructive connection with Atocha station, which is located in the southern part of the city, has led to the continuation of tourism in this urban area. Chamartin is the second-largest railway station in Madrid and the connection of regional and intercity railways. This station was built and operated between 1970 and 1975.

Atocha is the largest railway station in central Madrid, with a variety of city functions nearby. The station was opened in 1851, rebuilt in 1892 due to a fire, and fundamentally rebuilt in 1992. The connection of the Atocha and Chamartin stations in Madrid led to the regeneration project of the city, called the "De LA Castellana" promenade (Fig. 3). The connection between these two stations is the link between the most important areas and tourist attractions for the benefits of tourism in Madrid. The most important spots can be referred to the Columbus Towers, Santiago Bernabéu Stadium, Castilla square, the natural history museum, Eduardo Dato promenade, and Colon square. Moreover, the area is more than a million and a half square meters (equivalent to 170 football pitches) for uses as Equipment, urban services, and green areas [Ataran, 2016]. Dimensions and implementation policies of urban regeneration are documented In Table 4.

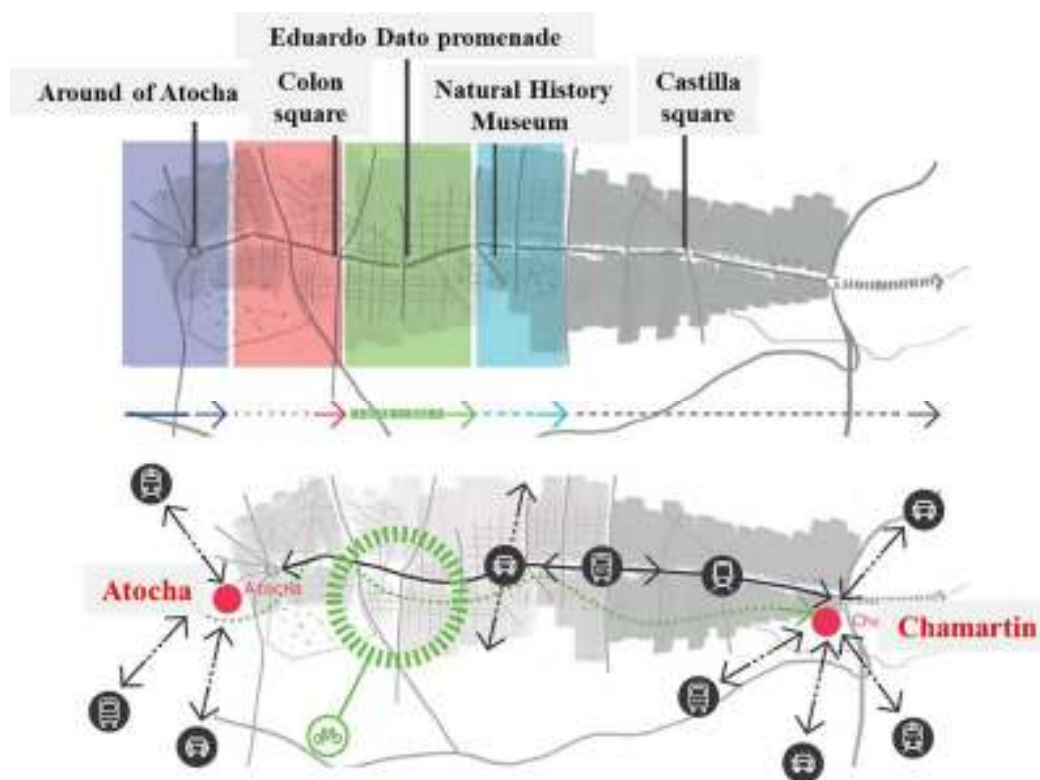


Fig. 3. The concept of "connecting the links of the chain" in the urban passage of "De LA Castellana"

Table 4: Dimensions and Indicators of urban regeneration approach for locating railway passenger stations

Development strategies	implementation policies/criteria	
Establishing functional links and connecting with urban centers	accessibility	Accessibility between the station and other modes of transport and pavements
Accessibility to public transportations and parking management		Proximity to commercial, tourism, and historical sites
Improving land uses diversity and creating pedestrian access		
Preservation of historical sites and redevelopment of brownfields	development	Locating in infill development capability areas such as brownfields

Utilizing the tourism industry, increasing employment opportunities, and strengthening social relations		locating in a situation with a proper density of residences and activities
Preservation of urban spaces and natural environment	environmental harmony	Preserving natural habitats and preventing the destruction of the natural environment and Farmlands
Creating new urban spaces while maintaining the main spatial features		

[Roberts and Sykes, 2000], [Cowan, 2005], [Paumier, 2004], [Ataran, 2016], [Abedi, 2017]

4. Case study for Railway Passenger Station Site Selection in Iran

In Iran, the location of railway passenger stations is enacted by the railway station location committee after the necessary expert studies. In this section, after a brief introduction of the studied cases including Rasht, Aligudarz, and Birjand stations, common indicators of locating these stations are given (Fig. 4). Rasht Station: Rasht is one of the metropolises and the capital of Gilan province in northern Iran. This metropolis is the largest and most populous city in northern Iran, comparing the neighboring provinces of the Caspian Sea. Rasht is also the third most visited tourist city in Iran. The Qazvin-Rasht railway project is a part of the north-south corridor of Iran (including a large part of Asian and European countries). Aligudarz Station: Aligudarz is a city in the east of Lorestan province and the fifth most populous city in this province. Aligudarz railway station connects this city to the national railway from north to south of Iran. Birjand Station: Birjand is the capital of South Khorasan province in eastern Iran. This city has many historical sites and is one of the largest cities in Iran. Zahedan-Birjand railway project is aimed at developing rail transportation in eastern Iran, which includes connecting Birjand as the capital of South Khorasan province to the railway network. the image below shows the location of the mentioned cities.



Fig. 4. Location of Rasht, Aligudarz, and Birjand cities in Iran

In the following, Common principles and Criteria for railway passenger station site selection in Iran are listed:

- Accessibility to urban centers and functions (such as main urban passages, parking spaces, and commercial centers, etc).
 - Integration with other modes of public transport
 - Locating in suitable lands for the development of the city in the future
 - Reducing environmental destruction and eliminating all types of pollutions
 - Preservation of natural buffers in the vicinity of stations
 - Considering project costs and economic efficiency
 - Observance of the railway and geological characteristics (such as slope and topography)
- [Railway Station Location Committee, 2019].

Regarding the above criteria, it is possible to divide each of them into more general categories including accessibility, development, rail-related and economy, and environmental harmony. This implies that the mentioned division for proposing criteria of this paper can be both reliable and practical for locating railway passenger stations.

5. Results

Taking into account the theoretical literature reviewed in the previous sections, including the Transit-Oriented development and urban regeneration approaches, successful examples, and Case study of some railway passenger stations in Iran, we propose four major criteria including accessibility, development, Rail related and economics, and environmental harmony as the optimal criteria for locating railway passenger stations (Table 5).

Table 5: Criteria for railway passenger station site selection

Criteria	Sub-criteria
accessibility	accessibility to urban centers and functional hubs
	Accessibility to major centers of Trip Generation and attraction (such as commercial, tourist, and historical centers)
	Accessibility to city transport systems and creating multimodality
	Accessibility to main urban streets, pavements, and parking spaces
	Accessibility to the infrastructural installations
development	Locating in the desired areas of urban development in the current and future situations
	Locating in suitable lands for redevelopment (such as brownfields)
	Locating in areas with higher land-use density
Rail related and economics	Locating based upon costs and economic efficiency
	Observance of the railway and geological characteristics (such as slope and topography)
	Possibility of creating added value for the region
environmental harmony	Avoiding destruction of natural habitats and farmlands
	Preservation of natural buffers (such as faults, rivers, and natural lands)
	Avoid Noise, air, and visual pollutions

6. Discussion and Conclusion

As we discussed in the previous sections, the most important purpose of this research was to develop a theoretical framework including criteria and sub-criteria for railway passenger station site selection based upon reliable literature. In order to recognize which theoretical approaches are useful concerning the purpose of the research, the Library research method was

considered. This research showed that the two major approaches in urban planning, consist of Transit-Oriented Development urban regeneration, are the most relevant to the aim of the paper. In the following paragraphs, we summarized the main conclusions, which are the answers to the questions raised at the beginning of the paper:

- 1) The first approach related to the paper topic is Transit-Oriented Development. In this part of the paper, important and basic definitions, policies, and general principles of Transit-Oriented Development, the role of railway stations in Transit-Oriented Development, and Hufenhof station as a successful example based on this approach were reviewed. Eventually, regarding previous cases and development strategies, implementation policies were derived (Table 2).
- 2) The second approach related to the research topic is urban regeneration. In this part of the paper, the definition and Principles, the need to pay attention to railway stations in urban regeneration, and the project of regeneration of Madrid were reviewed. Eventually, regarding previous cases and development strategies, implementation policies were derived (Table 4).
- 3) By studying the real procedures in the field of urban planning to determine the location of railway passenger stations in Iran by the Station Location Committee, the common criteria of three stations of Rasht, Aligudarz, and Birjand were derived. This procedure, along with the theoretical findings of the reviewed approaches, is proof for proposing a group of applicable criteria.

By reviewing the criteria extracted from each of the previous cases, the proposed paper framework was derived. (Table 5) Comparison of the proposed criteria of this paper with the implementation policies, Literature review, and previous studies (as mentioned in the Introduction) shows that the Criteria are reliable for locating railway passenger stations in different geographical locations. However, geographical differences and specific conditions of each location may lead to the addition or subtraction of some other criteria to the items proposed in this paper.

References

- Abbaszadegan, M., Rezazadeh, R., Mohammadi, M., 2011. 'Transit Oriented Development and Role of Tehran Subway System', The Monthly Scientific Journal of Bagh-e Nazar, 8(17), pp. 43-58.

- Abedi, M.J. 2017. Design of Urban Spaces on the Riverfront with The Regeneration Approach, Case Study: Riverfront of Kabul in The City Centre, Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Art (M.A) in Urban Design, Tarbiat Modares University.
- Arrington, G.B. and Parker, T., 2001. Factors for success in California's transit-oriented development. Sacramento: California Department of Transportation, Statewide Transit-Oriented Development Study.
- Ataran, M., 2016. The Role of Railway Stations in Urban Regeneration, Tehran, a joint task force of Islamic Republic of Iran Railways and Urban Development and Revitalization Corporation, p. 39
- Bakhtiari, A., 2016. Transit-Oriented Development Approach, The Role of Railway Stations in Urban Regeneration, Tehran, a joint task force of Islamic Republic of Iran Railways and Urban Development and Revitalization Corporation, p 28
- Bernick, M. and Cervero, R., 1997. Transit Villages in the 21st century.
- Calthorpe, P., 1993. The next American metropolis: Ecology, community, and the American dream. Princeton architectural press.
- Couch, C., 1990. Urban renewal: theory and practice. Macmillan International Higher Education.
- Cowan, R. and Rogers, L., 2005. The dictionary of urbanism (Vol. 67). Tisbury: Streetwise press.
- Dittmar, H. and Ohland, G. eds., 2012. The new transit town: Best practices in transit-oriented development. Island Press.
- Farkas, A., 2009, June. Route/site selection of urban transportation facilities: an integrated GIS/MCDM approach. In 7th International Conference on Management, Enterprise and Benchmarking June (pp. 5-6).
- Glendening, P.N., 2000. Speech by Maryland Governor Parris N. Glendening. Journal of Health Care Law and Policy, 4(1), p.9.
- Liu, T., Zou, Y. and Xie, R., 2010. A comprehensive evaluation method of adding passenger stations in the existing intercity railway line. DOI: 10.1049/cp.2010.1099
- Loo, B.P., Chen, C. and Chan, E.T., 2010. Rail-based transit-oriented development: lessons from New York City and Hong Kong. Landscape and Urban Planning, 97(3), pp.202-212, <https://doi.org/10.1016/j.landurbplan.2010.06.002>.

- Mohajeri, N. and Amin, G.R., 2010. Railway station site selection using analytical hierarchy process and data envelopment analysis. *Computers & Industrial Engineering*, 59(1), pp.107-114, <https://doi.org/10.1016/j.cie.2010.03.006>.
- Niles, J. and Nelson, D., 1999, April. Measuring the Success of Transit-Oriented Development: Retail Market Dynamics and Other Key Determinants. In *APA National Planning Conference*. Seattle, WA. Retrieved January (Vol. 28, p. 2003).
- Paumier, C.B., 2004. *Creating a vibrant city center: urban design and regeneration principles*, Urban Land Inst.
- Peters, D., 2009. The renaissance of inner-city rail station areas: a key element in contemporary urban restructuring dynamics. *Critical Planning*, 16, pp.163-185.
- Peters, D. and Novy, J., 2012. Train station area development mega-projects in Europe: Towards a typology. *Built Environment*, 38(1), pp.12-30, <https://doi.org/10.2148/benv.38.1.12>.
- Porter, D.R., 1998. Transit-focused development: a progress report. *Journal of the American Planning Association*, 64(4), pp.475-488, <https://doi.org/10.1080/01944369808976006>.
- Railway Station Location Committee., 2019. Location report of Aligudarz, Birjand, and Rasht stations, The railways of the Islamic Republic of Iran, Ministry of roads and urban development of Iran.
- Roberts, P., 2000. The evolution, definition, and purpose of urban regeneration. *Urban regeneration*, pp.9-36.
- Shaad, R. Mofidi, H. Moghadam, S. and Amin, M., 2015. Spatial evaluation of railway stations in Khorasan Razavi province by TOPSIS method and GIS, *journal of transportation research*, volume 12.
- Soltaniehha, M., Niedermaier, M. and Sonderegger, R., 2016. Challenges and Chances for SBB in Small and Mid-sized Communities: Railway Stations and Spatial Development in Small and Mid-sized Communities in Switzerland. *ETH Zurich*.
- Yu, J., Liu, Y., Chang, G.L., Ma, W. and Yang, X., 2011. Locating urban transit hubs: Multicriteria model and case study in China. *Journal of Transportation Engineering*, 137(12), pp.944-952, [https://doi.org/10.1061/\(ASCE\)TE.1943-5436.0000275](https://doi.org/10.1061/(ASCE)TE.1943-5436.0000275).

The Energy Potential of Biomass of Post-mining Spoil Heaps (South Poland)

Łazaj Alicja, Edyta Sierka

Abstract— Nowadays, the main biomass sources are energy crops, forestry, and partly agriculture. In order to limit the intake of land intended for food cultivation while striving to increase the percentage share of biomass in renewable energy sources (RES) production (EU Policy 2030), biomass resources from industrial wastelands may be used as an alternative local solution. In such areas, there are often single-species, extensive fields of wild-growing invasive species, such as the goldenrod *Solidago gigantea* (SG), which produce, on average, $1.01\text{--}4.5 \text{ kg} \cdot \text{ha}^{-1}$ biomass - comparable to $4.9 \text{ kg} \cdot \text{ha}^{-1}$ of maize crops. Therefore, it is important to study the potential and energy parameters of these species and to assess the possibility of using them in the production of renewable energy. The main goal of the research was 1) determining the parameters essential for the use of SG biomass in the energy sector and 2) giving the areas transformed by man new functions within the concept of a circular economy. *Solidago gigantea*, which forms a monoculture on a hard coal heap, was selected for the research. The methods of classification of the time series of multispectral images WorldView-2, covering various phases of vegetation, were used to locate biomass on the studied objects. Sg biomass was collected in accordance with the guidelines of PN-EN ISO 18135: 2017-06. Then, the combustion characteristics, humidity, volatile matter content, and ash content were determined. The analysis of the energy potential of the model species was also enriched with a petrographic assessment. The conducted research allowed to compare the properties of the energy parameters of the model plant's biomass to the parameters of native plants and other standard species used for energy purposes. Determining the energy potential of the invasive species –goldenrod *Solidago gigantea* allows for the recommendation of the species' biomass to begin work on using it in distributed energy installations.

Keywords— biomass, brownfields, heap, invasive species, *Solidago gigantea*.

Estimation of Saturated Hydraulic Conductivity for Different Soil Types in Jimma Zone, Ethiopia

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Abstract: A saturated hydraulic conductivity (K_{sat}) is the utmost vital soil hydraulic parameter for flow with in the soil. The knowledge of it is vigorous for water resources applications. Numerous methods & models (field, laboratory and empirical formulae) are available for determination of it. However, all of them have their applications and limitations. But, most investigators prefer the usage of empirical formulae to direct measurements of K_{sat} (field / lab) as direct measurements are very challenging (sometimes impractical), necessitating testing, quantification, and decision; making it extremely difficult to use in hydrologic modeling. Thus, it is vital to effectively assess the illustrative K_{sat} values matching the cost and its reliability. This study therefore presents the laboratory estimation of the K_{sat} for different soil textures in

Jimma zone (nearby Jimma, Serbo, GilgelGibe and Asendabo towns) in Ethiopia, by both constant head and falling head methods, which are the simplest and cost effective ones. In these procedures, we determined the K_{sat} values of the soil in the study region. The results indicated that its average values are (1) in between 0.00124 and 0.00173cm/s for sandy-loam soil, and (2) 0.000124cm/s for clay soil. The porosity of soil samples were also calculated and found out to be in the range of 41.25 % and 44.24 % (the average being 43.04%) for sandy-loam soil and 43.54% for clay soil. We then compared the results with the corresponding values in the literature, and finally we concluded that the K_{sat} and porosity values obtained for the study region were found to be in a good agreement with the corresponding literature values.

Keywords: Permeability test, Porosity, Saturated Hydraulic Conductivity, Soil textures, Jimma, Ethiopia

I. INTRODUCTION

K_{sat} can be defined as the easiest situation with which voids of a saturated soil transport water within it. Basically, it is the constant of proportionality that shows the association of the rate of water flow to hydraulic gradient in Darcy's Law. It is directly related to the effective porosity of the soil [2]. This is often used for the correlation of K_{sat} values with other hydraulic properties of the soil such as water-holding capacity and drainable pore space [33]. The knowledge of this K_{sat} parameter is vital (1) for water resources applications like the designs of flood control structures, earthen dams, subsurface drainage systems, etc., (2) for determination of seeping water with in the body earth dams or underground structures built on the coarser foundations, (3) for the estimation of water flow from waste storage arrangements (landfills, ponds, etc.), and (4) for estimation of settlement of deposits of finer soil materials. It can also help provide an improved flood risk management and runoff forecasting. Topography and land use/land cover are amongst the chief factors that influence K_{sat} of the soils [15, 21]. It is generally the essential element for efficient and effective use of land and better water resources management. However, direct quantification of the K_{sat} parameter is challenging and expensive[22] under field/laboratory situations, and even it is unfeasible for many hydrologic studies [24]. Due to that, soil researchers and engineers have strongly examined its assessment during the last numerous

decades. Accordingly, several models/ pedotransfer functions (PTFs) were established to assess the typical K_{sat} values with readily available soil information [12, 21, 22, 24, 25, 29]. These estimates are mainly based on the grain size of the soil. However, Sobieraj *et al.* [30] assessed the suitability of nine K_{sat} PTFs comprising the Rosetta model in modeling stream flows from rainforest catchment and found them imprecise. Whereas, Minasny and McBratney [16] also investigated eight suggested K_{sat} PTFs using the Australian soil information and obtained that the PTFs of Dane and Puckett (1994), Cosby *et al.* (1984), and Schaap *et al.* (1998) showed the good estimates for sandy, loamy, and clayey soils, respectively. The Saxton *et al.* [25] texture based technique of K_{sat} approximation has been effectively implemented to a wide-range of applications. Other approaches have also given comparable outcomes but with limited precision [13,22]. Jarvis *et al.* [13] examined that few empirical methods to assess the K_{sat} have been suggested, on the basis of either the particle diameter [3], 'porosity' [2], or water holding parameters of the soil. Nevertheless, these approaches may be more appropriate for forecasting the K_{sat} , without the effects of macro pore [13]. K_{sat} was well forecasted with the improved form of Campbell's (1985) technique for Australian soils instead of the particle's geometric mean diameter [29]. Rawls *et al.* [22] suggested a technique to forecast K_{sat} from bubbling pressure and effective porosity, but the forecasts were not associated with investigational data. It can be renowned that though the

assessment techniques of Ksat on the basis of bubbling pressure and pore size distribution index have the benefit of being physically based, such information may not be effortlessly obtainable for bigger areas. Likewise, they might not be so vigorous, as Ksat is inversely associated with the square of the bubbling pressure that in turn is not well-defined by experiments, nor simple to forecast from the substitute variables. Saxton and Rawls [24] carried out an investigation to inform the Saxton *et al.* [25] soil water tension equations from a large USDA soils information and combine the amended Ksat expression of Rawls *et al.* [21] to give a commonly appropriate estimation technique. Ksat approximations by the Saxton and Rawls [24] approaches were calculated on the basis of %'s of sand and clay, and amended by using %'s of gravel & OM (organic matter), and the bulk density of the soil. In this case, the statistical analyses using measured soil water properties and the USDA soils database yielded correlation coefficients of about 0.6-0.75. The model outcomes varied in their approximation of each of the measured values, indicating that using estimated soil hydraulic properties directly may result in unreasonable errors if not confirmed by validation studies.

Furthermore, three readily applicable models have been developed to accurately describe the relationships between soil texture data and Ksat [2,25,29]. Although these models have been widely confirmed, appraised, accepted, and used, their accuracy has been observed to be limited. Duan *et al.* [7] studied to appraise if the Campbell [3], Saxton *et al.* [25] and Smettem *et al.* [29] models sufficiently forecast Ksat based soil texture data of Texas lawn soil. The outcome showed that there were relatively large errors when the models were utilized for Ksat estimation. The absolute value of mean relative error for the Smettem and Bristow model (69%) was greater than for the Campbell model (34%) and the Saxton *et al.* model (36%).

Rawls *et al.* [22] advised that in order to incorporate soil water physics into hydrologic modeling, the relationships between matric potential and Ksat as a function of soil water content must be specified. However, establishing these relationships is both expensive and time-consuming, making this approach unsuitable for use in watershed hydrologic modeling. To overcome these challenges, a thorough search of the literature and data sources for Ksat and related soil-water data was conducted in 1978, with the goal of providing the best estimates possible from the earlier analysis. The Brooks and Corey parameters, soil retention volumes, total porosity, and Ksat for the major USDA soil texture classes were developed from this search [22]. These are the comprehensive typical descriptive results of the soil hydraulic properties well-defined for USDA soil texture classes by joining the outcomes of several research reports in the literature.

Saxton and Rawls [24] showed that using the Ksat data set compiled by Mualem [17], a set of mean Ksat results were established based on the USDA soil texture and were then associated with the investigation result of Rawls *et al.* [22]. The Mualem values were equivalent to those of Rawls *et al.* [22] additionally confirming the appropriateness of Ksat results of Rawls *et al.* [22]. But, the association established by Rawls *et al.* [22] provides a satisfactory estimation Ksat values for applications where further complete information are not obtainable. Since, these results cannot precisely describe the soil hydraulic properties of any specific soil based on the soil texture only, even if the soil texture is the key element. Each soil has additional physical characteristics that may bring the deviation.

Consequently, the accuracy of using indirect methods for Ksat estimation based on soil texture was found to be relatively low. Enormous errors in some cases and better precision in the other cases were detected. In summary, there is no best possible measurement technique for Ksat. These are main reason why many methods/models, as described above, have been established in the past to quantify of the Ksat [15]. Unluckily, as Ksat is extremely sensitive to sample size, pore geometry, and soil characteristics, these methods/models frequently yield significantly divergent results. Thus, most of the Ksat estimation approaches were found to be neither appropriate for all applications nor precise for all soil types and conditions. Hence, this brief review showed that estimating the Ksat values remains challenging and uncertain, requiring testing, measurement, and judgment. Consequently, expecting extremely high accuracy, regardless of approach, is unrealistic. Thus, it is desirable to effectively assess a representative value of the Ksat while balancing between cost and accuracy. In general, Ksat estimation should carefully be assessed locally to confirm that the values so obtained shall be more accurate and appropriate for the required purpose. Various authors also suggested that, for estimation of Ksat, locally derived equations from readily obtainable soil information can be more precise than using the established estimation models [33]. This paper thus presents the estimation of Ksat for different soil textures in Jimma zone, Ethiopia, by both constant head and variable/falling head permeability test procedures. These test procedures are very simple, practical, cost effective, and are well within the capability of professional engineers and soil scientists, and they can also give the Ksat values with an acceptable accuracy. The constant head test technique is used for soils with the Ksat value more than 10^{-4} cm/s and the variable/falling head test technique is chiefly utilized for fine grained soils ($K_{sat} < 10^{-4}$ cm/s).

II. MATERIALS AND METHODS

A. The Study Area

This study was conducted in Jimma zone of Oromia regional state in Ethiopia (Figure 1). Four experimental sites (nearby Jimma, Serbo, Gilgel Gibe and Asendabo towns) were selected for this study. These sites are found in Gilgel Ghibe catchment which has a drainage area of about 2943 km² at its flow outlet defined by “Ghibe Nr Asendabo” gauging station [20]. Gilgel Ghibe river catchment is one of the tributaries of the Ghibe River [9]. It is geographically located in between 7°20'01.58"N to 7°59'15.32"N latitudes and 36°31'04.91"E to 37°13'31.07"E longitudes. It is categorized as high hills with the elevations within 1690m and 3305m a.s.l. The catchment's land-use is consisted of unplanted bare lands (28.6%), forest-lands (13.5%), wood=lands (28.8%), grass-lands (15.7%), and bush/shrub lands (13.1%), and built-up and water (0.3%) [19]. The climate of the catchment is partially humid, warm to hot with average monthly temperature is 19°C (minimum 2.5 °C, and maximum 32.6°C). Two seasons are known in the catchment; the dry and the rainy. The rainfall is mono-modal rainfall pattern (June-September) called summer. The summer precipitation

represents 50-80 % of yearly precipitation aggregates over the catchment [6]. The average yearly precipitation and runoff of the basin are about 1456 mm and 565mm, respectively [20]. Since most of the yearly rainfall happens within June and September months, in these months, catchment-wise strong precipitation continuously happen, in so doing leading to extreme floods. The average yearly evapotranspiration of the basin is roughly 1316 mm, and its main soil categories are Clay, Clay loam, and Sandy loam & Loam (HWSD) [10]. The main socio-economic events in the area are cultivating crops (maize, teff, sorghum, barley, etc.) and rearing of animals [6]. The history of land use and soil management of the selected experimental sites of the catchment indicated that the sites were under continuous cultivation for cereal crops (such as corn, teff, etc.), followed by cattle grazing on grass pasture for the last 10 years. We then intentionally selected two of the experimental sites to be under no-tillage and the other two to be under conventional tillage, each consisted of approximately 10m by 10m. This study was accomplished in months between February and March of 2021 after the corn was planted in February.

TABLE I
DETAIL OF EXPERIMENTAL SITES (JIMMA, SERBO, GILGEL GIBE AND ASENDABO)

Experimental sites	Longitude	Latitude	Altitude (m)
Jimma	36°50'17"	7°40'30"	1721
Serbo	36°58'44"	7°41'42"	1782
GilgelGibe	37°01'16"	7°45'18"	1694
Asendabo	37°08'17"	7°45'29"	1778

B. Experimental Approach

The Ksat is variable in space and time. Due to that estimation of Ksat is a difficult task involving testing, measurement and judgment. Even though, there are various methods available for estimation of the Ksat, each method/model has its own applications and limitations as described above. Nonetheless, there are relatively simple and low-cost laboratory tests (constant head and falling head techniques) for Ksat estimation. The constant head technique is suitable for relatively more pervious soils, while the falling head is more suitable for less pervious soils. The experiments were conducted in the laboratory of Civil Engineering Department, Faculty of Civil and Environmental Engineering, Jimma University,

Ethiopia. In this study, the texture class soil was obtained by the hydrometer system. The texture of the soil is the property of a soil used to describe the comparative quantity of different grain sizes of the soil. Particles are arranged into the soil separates as clay [$<0.02\text{mm}$], silt [$0.02\text{--}0.05\text{mm}$], and sand [$0.05\text{--}2.00\text{mm}$]. The porosity, that shows the percentage volume of voids of the soil sample, was obtained with the help of the saturation method. It dictates how much water is required to saturate the soil material and has a key factor that affect the bulk properties of root zone in the soil. The Ksat was determined for the different soil textures identified from the soil samples collected from the experimental sites using the constant head and the variable/ falling head techniques as briefly described here-under.

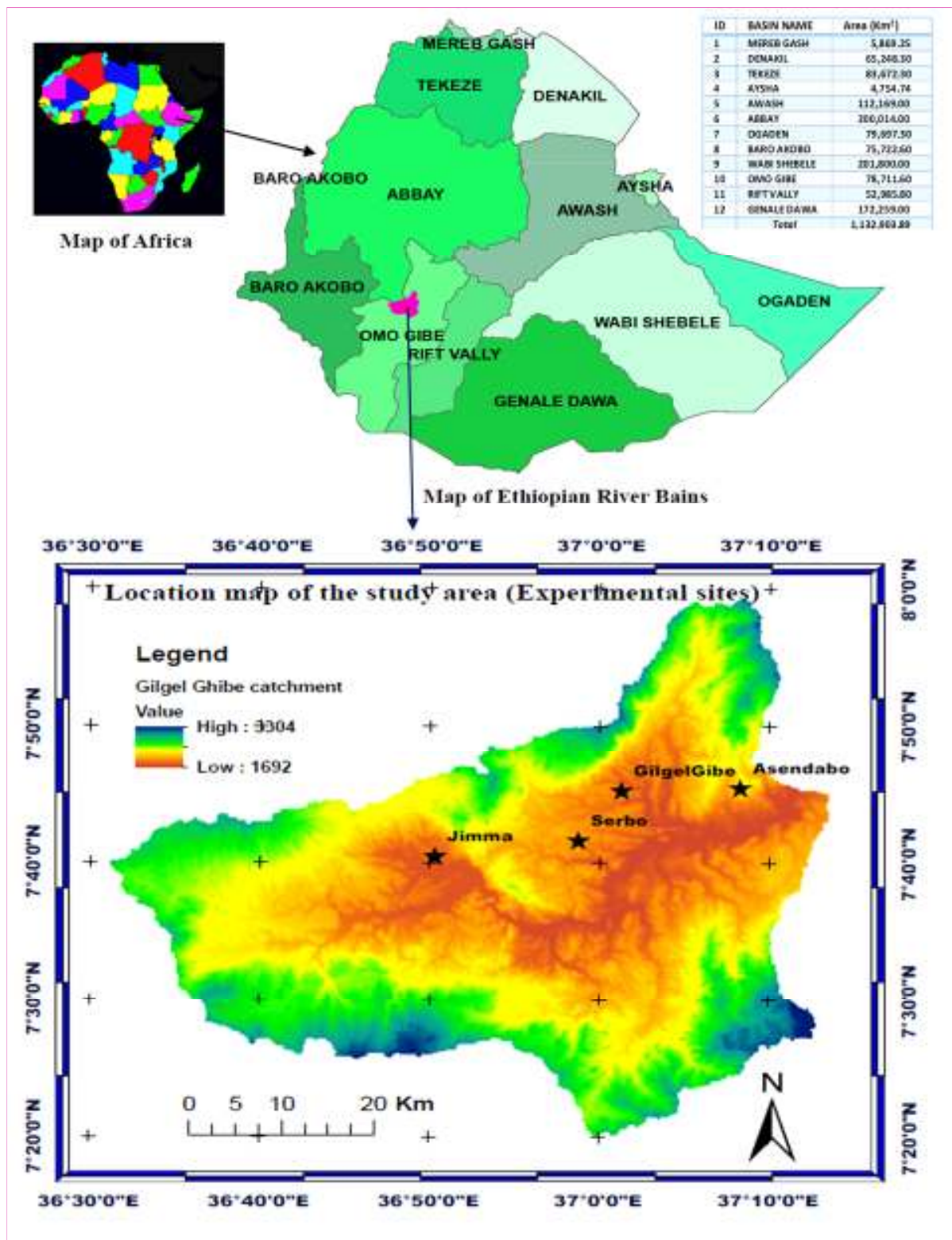


Fig. 1 Locational map of the study-area

C. Constant Head Method

The test in this technique is conducted using the Constant Head Permeameter. Figure 2 (a) demonstrates a diagrammatic illustration of Constant head permeability test. The device is fitted with an adjustable flow of water -reservoir and an outlet that allows preserving a constant head through the test. The procedure allows flow to move through the soil under a steady state condition. In this case, after completely saturating the soil sample, the water was allowed to flow for some time till the steady state flow was achieved. Then, the quantity of water-flow through the column of the soil was measured for specified time interval, t . Measuring the height of the soil column L , the cross sectional of the sample A , and the constant difference in the heads of the manometers Δh , the quantity of water passing through the sample column V , and the interval time t , the permeability coefficient (K) can be calculated by the following expression [23].

$$K = \frac{Q L}{A \Delta H} \quad (1)$$

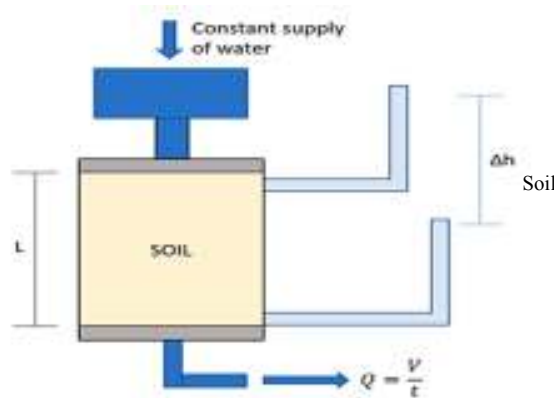
D. Falling/Variable Head Method

This technique is a typical laboratory test for determining the permeability of fine-grained soils such

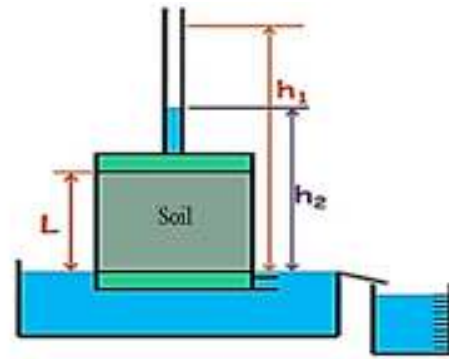
as silt and clay soils. Figure 2 (b) shows a diagrammatical illustration of the test apparatus that works the water head falling over time. In this test, the flow of water through a relatively short soil sample connected to a standpipe that provides the water head and also allows measuring the volume of water passing through the sample is used. The soil sample was saturated before the flow measurements began, and the standpipe was filled to a specified level with de-aired water. The test then began by allowing water to flow through the sample until the water level in the standpipe reached a predetermined lower limit. The amount of time it took for the water in the standpipe to drop from the upper to lower level was timed. The standpipe was frequently refilled, and the test was repeated a few times. The determination of permeability coefficient in this technique can be done by means of the expression [23].

$$K = \frac{a L}{A t} \ln \left(\frac{h_1}{h_2} \right) \quad (2)$$

where, a is the area of stand-pipe, L is length of the column the soil, A is the area of soil column, t is interval time of the head drop, h_1 & h_2 are the upper & lower levels of water in the stand-pipe from the reference datum.



(a) Constant head Method



(b) Falling head method

Fig. 2 Schematic representation of the permeability test

III. RESULTS AND DISCUSSIONS

Though there have been several efforts to classify the Ksat of the soil referring to USDA classes of soil texture (the easily obtainable property of the soil), the correctness of using such indirect approaches for Ksat estimation based on soil texture only was relatively low. Enormous errors in some cases and acceptable results in the other cases were detected. Thus, Ksat estimation should carefully be done locally to ensure that the

information so acquired shall be more accurate and appropriate for the required purpose. Consequently, to achieve the aims of our study, the constant head and the falling head permeability tests were conducted for estimating the Ksat in the laboratory. In this case, the collected soil samples were wisely analyzed using the experimental procedures described above and the results accordingly obtained were tabulated in Table 1 below.

TABLE II
CHARACTERISTICS OF THE EXPERIMENTAL SOILS COLLECTED FROM STUDY AREA

Sample #	%Clay ($< 0.002\text{mm}$)	% Silt ($0.002\text{--}0.05\text{mm}$)	% Sand ($0.05\text{--}2.0\text{mm}$)	Textural Class	Saturated Weight (g)	Dry Weight (g)	Core Volume (cm^3)	Porosity (%)
1	16.20	13.20	70.60	Sandy Loam	109.25	92.85	37.07	44.24
2	15.30	12.10	72.60	Sandy Loam	107.83	89.75	41.45	43.62
3	13.50	18.70	67.80	Sandy Loam	90.65	75.17	37.53	41.25
4	58.50	22.00	19.50	Clay	103.82	90.75	30.01	43.54

Table II thus explains the physical properties of the collected soil samples from nearby Jimma, Serbo, Gilgel Gibe and Asendabo towns in Jimma zone of Ethiopia. The soil textures of these four locations were obtained to be nearly the same all over the soil profile wherein sandy-loam majorly observed as per results of the analysis. The values of the soil porosity were calculated and found out to be in the range of 41.25 % and 44.24 % (the average being 43.04%) for sandy-loam and 43.54%

for clay soil texture classes for the four sampling locations. Following the experimental procedures of the constant head method, the required experimental data that can be used for the estimation of the Ksat by this method were collected from the representative soil samples. Finally, the Ksat values were calculated. The results were shown in Table III with the average Ksat value being 0.0013 cm/s for sandy- loam soil identified in the study region.

TABLE III
K_{SAT} VALUES OBTAINED BY THE CONSTANT HEAD METHOD FOR SOIL SAMPLES #1, #2, and #3

Test #	Volume of Outflow (cm^3)	Sample Length (cm)	Time (min)	Specimen Area (cm^2)	Constant Head (cm)	Ksat (cm/s)
1	315	8.5	5	176.72	38	0.00133
2	615	8.5	10	176.72	38	0.00130
3	915	8.5	15	176.72	38	0.00129

Figure 3 shows the Ksat estimated by the constant head permeameter for different soil samples, in which the correlation coefficient (R^2) of 0.9838 was observed

indicating that the estimated Ksat showed good agreement with the temporal variation for the soil samples.

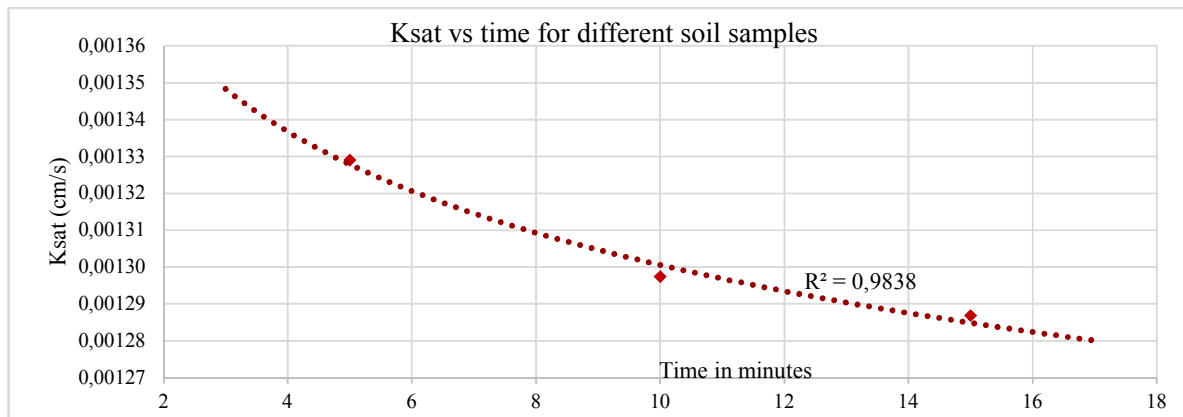


Fig. 3 Ksat Vs time by constant head method for different soil samples

Likewise, the representative Ksat values of the collected soil samples were estimated by the falling head method and the results so obtained were shown in Table IV. In this case, the average Ksat values obtained were 0.0124cm/s, 0.00173cm/s, 0.00147cm/s and 0.0000124cm/s for samples #1, #2, #3 and #4 respectively. These results indicate that the Ksat values

seem to be within 0.00124-0.00173 cm/s for sandy-loam soil and 0.000124cm/s for clay soil texture classes detected in the study region. The Ksat vs time plot for this method was also indicated in Figure 4 in that the estimated Ksat values revealed good agreement with the temporal variation for the soil samples.

TABLE IV
Ksat VALUES DETERMINED BY THE FALLING HEAD METHOD FOR DIFFERENT SOIL SAMPLES

Test No.	h ₁ (cm)	a (cm ²)	L (cm)	A (cm ²)	t (sec)	h ₂ , Sample #1	Ksat, Sample #1	h ₂ , Sample #2	Ksat, Sample #2	h ₂ , Sample #3	Ksat, Sample #3	h ₂ , Sample #4	Ksat, Sample #4
1	99	0.342	15	31.65	30	75	0.0015	70	0.001873	72	0.001721	96	0.000166
2	99	0.342	15	31.65	60	65	0.001137	53	0.001688	59	0.001398	95	0.000111
3	99	0.342	15	31.65	90	54	0.001092	40	0.001632	48	0.001304	94	0.000093
Ksat-average							0.001243		0.001731		0.001474		0.000124

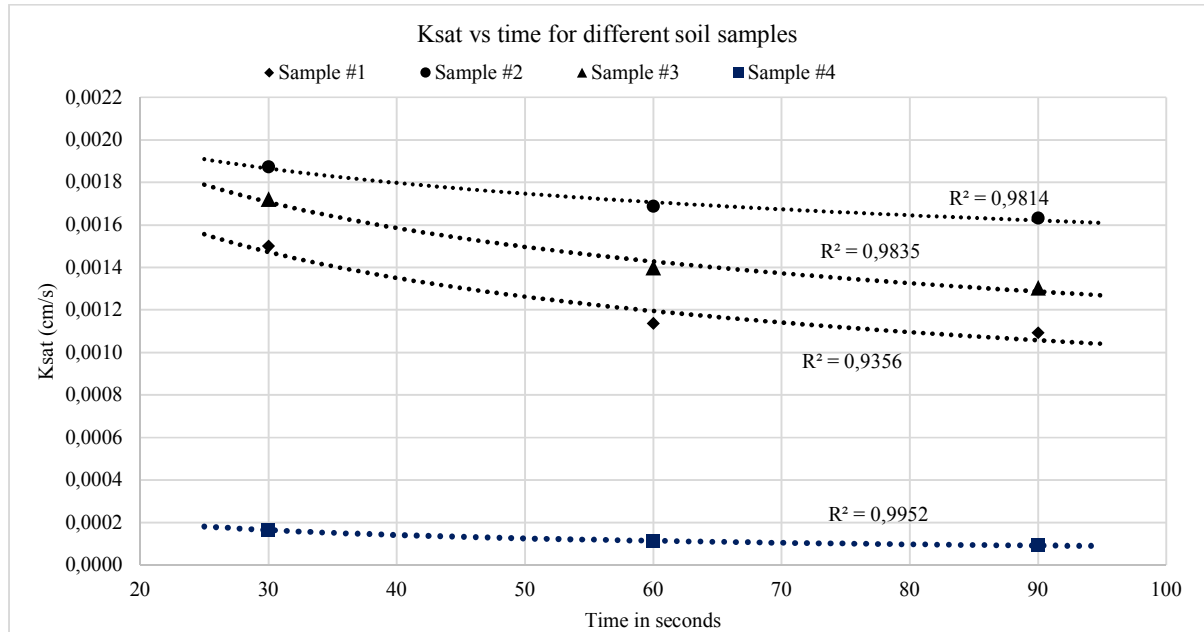


Fig. 4 Ksat values vs time by the falling head method for the experimental soil samples

Lastly, comparisons of the obtained results of the Ksat and porosity values with the corresponding literature values by Brooks–Corey model, Broadbridge–White model, Clapp–Hornberger model and vanGenuchten model (most frequently used models as indicated in

Table V) [28] was also carried out in Table VI. The overall result of the comparisons revealed that the Ksat and porosity values acquired in this study showed good agreement with those of the corresponding literature values for study region.

TABLE V
LITERATURE REPRESENTATIVE Ksat AND POROSITY VALUES FOR 11 USDA SOIL CLASSES [28]

Soil classes	Clapp–Hornberger model		Brooks–Corey model		Broadbridge–White model		van Genuchten model	
	Ksat (cm/s)	Porosity (%)	Ksat (cm/s)	Porosity (%)	Ksat (cm/s)	Porosity (%)	Ksat (cm/s)	Porosity (%)
Sand	1.76E-02	39.50	5.83E-03	43.70	1.76E-02	35.00	8.25E-03	43.00
Loamy sand	1.56E-02	41.00	1.70E-03	43.70	1.56E-02	40.00	4.05E-03	43.00
Sandy loam	3.47E-03	43.50	7.20E-04	45.30	3.50E-03	45.00	1.23E-03	41.00
Loam	7.20E-04	48.50	1.90E-04	46.30	7.20E-04	47.00	1.25E-04	45.00
Silt loam	6.95E-04	45.10	3.67E-04	50.10	6.95E-04	45.00	2.89E-04	43.00
Sandy clay loam	6.30E-04	42.00	1.20E-04	39.80	6.30E-04	40.00	3.63E-04	39.00
Clay loam	1.70E-04	47.70	6.39E-05	46.40	1.70E-04	45.00	1.97E-05	43.00
Silty clay loam	2.45E-04	47.60	4.17E-05	47.10	2.45E-04	50.00	7.18E-05	41.00
Sandy clay	2.17E-04	42.60	3.33E-05	43.00	2.17E-04	45.00	3.37E-05	38.00
Silty clay	1.03E-04	49.20	2.50E-05	47.90	1.03E-04	50.00	5.78E-06	36.00
Clay	1.28E-04	48.20	1.67E-05	47.50	1.20E-04	50.00	5.56E-05	38.00
Sand	1.76E-02	39.50	5.83E-03	43.70	1.76E-02	35.00	8.25E-03	43.00
Loamy sand	1.56E-02	41.00	1.70E-03	43.70	1.56E-02	40.00	4.05E-03	43.00

TABLE VI
COMPARISONS OF THE EXPERIMENTAL Ksat AND POROSITY VALUES WITH THOSE IN THE LITERATURE

Soil classes	Observed Data		Brooks–Corey model[28]		Clapp–Hornberger model[4]		Brooks–Corey model[28]		Broadbridge–White model[28]	
	Ksat (cm/s)	Porosity (%)	Ksat (cm/s)	Porosity (%)	Ksat (cm/s)	Porosity (%)	Ksat (cm/s)	Porosity (%)	Ksat (cm/s)	Porosity (%)
Sandy loam	1.24E-03 - 1.73E-03	43.04	3.47E-03	43.50	7.20E-04	45.30	3.50E-03	45.00	1.23E-03	41.00
Clay	1.24E-04	43.54	1.28E-04	48.20	1.67E-05	47.50	1.20E-04	50.00	5.56E-05	38.00

IV. CONCLUSION

Ksat is the key vital soil hydraulic parameter for flow in soil. The various methods & models available for determination of the Ksat were briefly reviewed to confirm the appropriateness and suitability of them. This critical review shows that all of them have their individual applications and limitations. Even though, most researchers prefer the use of empirical formulae to direct measurement of soil Ksat (field or lab) as the direct measurement is very challenging and occasionally unfeasible for many hydrologic analyses, it has been argued that the Ksat estimation of soil should depend on the local soil information. This study thus presents the estimation of the representative Ksat for different soil textures in Jimma zone (nearby Jimma, Serbo, GilgelGibe and Asendabo towns) in Ethiopia, by both the constant head and the falling head methods, which

are relatively simple and low-cost for estimation of the Ksat of the soil. The textural class of the soil were obtained by hydrometer technique, and showed sandy-loam & clay soil. The porosity of soil sample was calculated and found out to be in the range 41.25 % and 44.24 % (the average being 43.04%) for sandy-loam and 43.54% for clay soil textures for all of the experimental/sampling locations. The Ksat values of the soil samples was also estimated by both the constant head and the falling head methods. The results obtained indicated that its average values are within 0.00124cm/s and 0.00173cm/s for sandy-loam soil, and 0.000124cm/s for clay soil. We then compared the results accordingly obtained with the corresponding values in the literature. We finally concluded that the results of the Ksat and porosity values obtained in this study were found to be in a good agreement with the corresponding literature values.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

- [1] Abdul Sattar Shakir, Habib-ur-Rehman, Noor M Khan and AsadUllahQazi. Impact of canal water shortages on groundwater in the lower Bari Doab canal system in Pakistan, Pak. *J. Engg. & Appl. Science.*, 2011. 9 (July, 2011): p. 87-97.
- [2] Ahuja, L.R., J.W. Naney, R.E. Green and D.R. Nielsen. Macro-porosity to characterize spatial variability of hydraulic conductivity and effects of land management. *Soil Sci. Soc. Am. J.*, 1984. 48: p. 699–702
- [3] Campbell, G. S. Soil physics with basic: *Transport models for soil plant systems*, Elsevier Science, New York., 1985.
- [4] Clapp, R. B. and Hornberger, G. M. Empirical equations for some soil hydraulic properties, *Water Resour. Res.* 1978. 14: p.601–604. <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/WR014i004p00601>
- [5] Cosby, B. J., Hornberger, G.M., Clapp, R.B., and Ginn, T.R. A Statistical Exploration of the Relationships of Soil Moisture Characteristics to the Physical Properties of Soils. *Water Resources Research*, 1984. 20(6): 682-690.
- [6] Demissie, T.A. Climate change impact on stream flow and simulated sediment yield to Gilgel Gibe 1 hydropower reservoir and the effectiveness of Best Management Practices. Dr.Ing thesis, Rostock University, 2013.
- [7] Duan, R., Fedler, C. B. & Borrelli, J. Comparison of methods to estimate saturated hydraulic conductivity in Texas soils with grass. *J. Irrig. Drainage Eng.*, 2012. **138** (4). [https://doi.org/10.1061/\(ASCE\)IR.1943-4774.0000407](https://doi.org/10.1061/(ASCE)IR.1943-4774.0000407)
- [8] Dunn, G.H. and R.E. Philips. Equivalent diameter of simulated macro pore systems during saturated flow, *Soil science society of American Journal*, 1991. 55: p. 1244-1248.
- [9] EthioVisit.com . Major Ethiopia Rivers, 2021. URL: <https://www.ethiovisit.com/major-rivers-of-ethiopia/34/> (Accessed 17 june 2021).
- [10] FAO/IIASA/ISRIC/ISS-CAS/JRC. Harmonized World Soil Database (version 1.1). FAO, Rome, Italy and IIASA, Laxenburg, Austria, 2012. URL: http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/HWSD_Data.html?sb=4 (Accessed 29 June 2021).
- [11] Gray, W. G. and C. T. Miller . "Examination of Darcy's Law for Flow in Porous Media with Variable Porosity." *Environmental Science & Technology*, 2004. 38(22): p. 5895-5901.
- [12] Jabro, J. D. Estimation of saturated hydraulic conductivity of soils from particle size distribution and bulk density data. *Trans.ASABE*, 1992. 35 (2) :p. 557–560. <https://doi.org/10.13031/2013.28633>
- [13] Jarvis, N. J., Zavattaro, L., Rajkai, K., Reynolds, W. D., Olsen, P.-A., McGechan, M., Mecke, M., Mohanty, B., Leeds-Harrison, P. B. & Jacques, D. Indirect estimation of near-saturated hydraulic conductivity from readily available soil information. *Geoderma*, 2002. 108: p. 1 -17.
- [14] Klute A. (ed). Methods of soil analysis, part 1, physical and mineralogical properties, *Amer. Society, Agronomy, Monograph 9*, 1986. 2nd ed. Madison, Wisc., USA.

- [15] Klute, A. Laboratory measurement of hydraulic conductivity of unsaturated soils, in methods of soil analysis, Edited by C.A. Black, D.D. Evans, J.L. White, L.E. Ensminger, and F.E. Clark. Monograph 9, Part 1, *American Society of Agronomy*, Madison, 1965. Wis. pp. 253–261.
- [16] Minasny, B. & McBratney, A. B. Evaluation and development of hydraulic conductivity pedotransfer functions for Australian soil. *Aust. J. Soil Res.*, 2000. 38 : p. 906–926. <https://doi.org/10.1071/SR99110>
- [17] MUALEM, Y. A new model for predicting the hydraulic conductivity of unsaturated porous media. *Water Resour. Res.*, 1976. 12: p. 513–522. <https://doi.org/10.1029/WR012i003p00513>
- [18] Muhammad Akram Kahlowan and Abdul Majeed. Water resources situation in Pakistan: Challenges and Future Strategies, *Journal of Science Vision*, 2002. 7(3&4).
- [19] Negash F. Managing water for inclusive and sustainable growth in Ethiopia: Key challenges and priorities, 2012. Addis Ababa, Ethiopia.
- [20] Rabba, Z.A., Fatoyinbo, B.S. and Stretch, D.D. Applications of the PyTOPKAPI model to ungauged catchments. *Water SA*, 2018. 44 (2): p. 162–175. <https://www.ajol.info/index.php/wsa/article/view/170327>
- [21] Rawl, W. J., Gineaez, D. & Grossman, R. Use of soil texture, bulk density and slope of the water retention curve to predict saturated hydraulic conductivity *Transactions of the ASAE*, 1998. 41(4): p. 983–988.
- [22] Rawls, W., Brakensiek, D. & Saxton, K. Estimation of soil water properties. *Trans. of the ASAE*, 1982. 25(5): p. 1316–1320 and 1328.
- [23] Sarki, A., Mirjat, M.S., Mahessar, A. A., Kori, S.M. and Qureshi, A.L. Determination of Saturated Hydraulic Conductivity of Different Soil Texture Materials *Journal of Agriculture and Veterinary Science*, 2014. 7(12): p. 56–62. DOI: 10.9790/2380-071245662.
- [24] Saxton, K. E. & Rawls, W. J. Soil water characteristic estimates by texture and organic matter for hydrologic solutions. *Soil Sci. Soc. Am. J.*, 2006. 70 (5) :p. 1569–1578. <https://doi.org/10.2136/sssaj2005.0117>
- [25] Saxton, K. E., Rawls, W. J., Romberger, J. S. & Papendick, R. I. Estimating generalized soil water characteristics from texture. *Soil Sci. Soc. Am. J.*, 1986. 50 : p. 1031–1036. <https://doi.org/10.2136/sssaj1986.03615995005000040039x>
- [26] Schematic representation of constant head permeability test. URL: <https://www.vjtech.co.uk/blog/introduction-to-permeability-testing> (Accessed June 20, 2021)
- [27] Schematic representation of falling head permeability test URL: <https://elementaryengineeringlibrary.com/civil-engineering/soil-mechanics/falling-head-variable-head-permeability-method> (Accessed June 20, 2021)
- [28] Shao, Y., Irannejad, P. On the Choice of Soil Hydraulic Models in Land-Surface Schemes. *Boundary-Layer Meteorology*, 1999. 90 : p. 83–115 <https://doi.org/10.1023/A:1001786023282>
- [29] Smettem, K. R. J., Oliver, Y. M., Heng, L. K., Bristow, K. L. & Ford, E. J. Obtaining soil hydraulic properties for water balance and leaching models from survey data. 1. Water retention. *Aust. J. Agric. Res.*, 1999. 50 (2) : p. 283–289. <https://doi.org/10.1071/A97074>
- [30] Sobieraj, J. A., Elsenbeer, H. and Vertessy, R.A. Pedotransfer functions for estimating saturated hydraulic conductivity: Implications for modeling storm flow generation. *J. Hydrol.*, 2001. 251: p. 202–220. [https://doi.org/10.1016/S0022-1694\(01\)00469-3](https://doi.org/10.1016/S0022-1694(01)00469-3)
- [31] Stolte, J., freijer, J.I., bouten, W., dirksen, C., halbertsma, J.M., VanDam, J.C., Van Den Berg, J.A., Veerman, G.J. and Wosten, J.H.M. Comparison of six methods to determine unsaturated soil hydraulic conductivity. *Soil Sci. Soc. Am. J.*, 1994. 58: p. 1596–1603. <https://doi.org/10.2136/sssaj1994.03615995005800060002x>
- [32] Whitaker, S. "Flow in porous media I: A theoretical derivation of Darcy's law." *Transport in Porous Media*, 1986. 1(1): p. 3–25. <https://link.springer.com/article/10.1007/BF01036523>
- [33] Wösten, J. H. M., Schuren, C. H. J. E., Bouma, J., & Stein, A. Functional sensitivity analysis of four methods to generate soil hydraulic functions. *Soil science society of America journal*, 1990. 54(3): p. 832–836. http://ezproxy.utwente.nl:2048/login?url=https://webapps.itc.utwente.nl/library/1990/isi/stein_fun.pdf

Annealing Effect On Microstructure and Tensile Properties Development of Non-Equiatomic Ta_{0.5}Nb_{0.5}Hf_{0.5}ZrTi_{1.5} Refractory High Entropy Alloy

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Abstract:

The non-equiatomic Ta_{0.5}Nb_{0.5}Hf_{0.5}ZrTi_{1.5} alloy was prepared through an arc melting furnace and then severely deformed by a cryo-rolling process up to 90% thickness reduction. Further, the cryo-rolled specimens were subjected to an annealing treatment at 800°C and 1000°C temperatures. After the annealing process, both temperatures showed the presence of a single-phase BCC (body-centered cubic) structure. The room temperature tensile test results revealed that the tensile strength was 1210 MPa and elongation 10.5% for the 1000°C heat-treated condition.

Keywords: Refractory high entropy alloys, cryo-rolling, recrystallization, microstructure, tensile properties.

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1. Introduction:

The traditional way of the design of alloy is by selecting one or two base elements and considering other small amounts of alloying elements to achieve specific properties. Whereas high entropy alloys (HEAs) consisted of 5 to 20 elements with equiatomic or near equiatomic proportion, there was no major element common as conventionally alloys designed. The high number of alloying elements attributing high configurational entropy because of this property helps in preventing the formation of the intermetallic phases and increases the stability of a single solid solution phase FCC, BCC [1], [2]. The HEAs show better properties of high strength, hardness, excellent softening, wear, and corrosion resistance result of four core effects [2]-[11]. A new class of refractory high-entropy alloy (RHEA) designed by the concept of the high-entropy-alloys, indeed these materials have promising to be new superalloys because of their substantial mechanical properties at high temperatures. In the literature, it was found that the RHEAs, usually based on refractory elements like VNbTaCrMoWZrHf, have a stable microstructure and significant softening resistance at high temperatures [2]. So far developed a significant number of RHEAs show poor ductility at room temperature becomes difficult for processing and causes

limitations for their practical applications [2], [12]. The $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ alloy has good ductility and density; it could be a prominent alloy compared to some other RHEAs [13]. Interestingly $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ alloy was able to severely cryo-rolled, and subsequent annealing effect on the phase stability, microstructure, texture, and mechanical properties development was explored in the present research work.

2. Experimental Procedure:

2.1 Alloy Preparation and Processing

The non-equiatomic $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ prepared by melting in an arc melting furnace, starting with high purity Ta, Nb, Hf, Zr, and Ti constituent elements. The as-cast alloy block was subjected to mechanical polishing using emery papers, subsequently used for cold-rolling up to 50% reduction in thickness reduction. These rolled samples were next heat-treated at 1400°C for 10 min. The heat-treated samples (1400°C for 10 min) were used as starting material for further deformation. The starting material is processed by cryo-rolling up to 90% reduction in thickness in multiple passes. During the cryo rolling process specimens were dipped in a liquid N_2 can and immediately passed through rolls. The severely cryo-rolled samples are utilized for annealing treatment at temperatures 800°C and 1000°C for 1h, followed by instant water quenching. The rolled samples were encapsulated in a quartz tube under a vacuum to prevent oxidation during the heat-treatment process. Further, annealed samples are mechanically polished by emery paper until 2000 fine grade to remove if there is the presence of an oxide surface after that further characterization is done.

2.2 Characterization and Mechanical Testing

The phase analysis of the $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ samples was carried out using x-ray diffraction (Rigaku Ultima) with Co source λ is 1.78 \AA . The microstructure and texture exploration for all annealed samples was carried out by utilizing an EBSD (electron backscatter diffraction) (Oxford Instruments, UK) system which is a part of the attachment to a scanning electron microscope (SEM) (Carl-Zeiss, Germany; Model: SUPRA 40). The specimens to perform EBSD experiments prepared by both mechanical polishing up to mirror surface finish and followed by electropolishing process in electrolyte: perchloric acid and methanol with 1:9 ratios by volume. The EBSD scans in SEM were acquired through the AztecHKL software (Oxford Instruments, UK). Then further acquired all EBSD datasets for all conditions exported to the TSL-OIMTM software (EDAX Inc., USA). The ODFs (orientation distribution functions) were calculated from these datasets by making use of the harmonic series expansion method (series rank = 22). The cut-off angle of 15° degrees was utilized to extract volume fractions of different texture components. The Tensile test at room temperature was carried out at 10^{-3} mm/sec strain rate using (Instron 5967, embedded with DIC).

3. Results and Discussion:

3.1 Annealing Microstructure and Texture Development:

The $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ RHEA was annealed at 800°C and 1000°C temperatures for 1h XRD peaks indexed as a single bcc phase (Fig. 1a). Apart from this, the XRD results, indicating that there was no phase transformation occurred. Fig2. (a, c) shows microstructures development during isochronal annealing for 1h at different temperatures for the 90% cryo-rolled materials. The material appears completely recrystallized (cryo-rolled 90%) after annealing at 800 °C, it can be seen from the microstructure, and composed of approximately few equiaxed grains with the overall mean size 8.98 ± 5.8 (Table1). Moreover, the microstructural inhomogeneity features revealed by regions composed of relatively large recrystallized grains (marked by white arrow) in Fig. 2 (a) existing with regions consisting of small grains (enclosed by circles in Fig. 2 (a)). Furthermore, similar morphological features in Fig. 2 (c) and coarse microstructure development happened for 1000 °C annealed condition has a mean grain size of 53.42 ± 34.93 (Table1) it is evident that the grain size found to increase with temperature, indicating that temperature actively contributed to grain growth. Interestingly some of the recrystallized grains in both annealed microstructures are oriented along the 35°–65° direction (marked by the red arrow in Fig. 2 (a, c)) from the rolling direction because the recrystallization occurs preferentially along the shear bands formed during rolling [14]. Besides, the nuclei of recrystallized grains originate from the pre-existed deformed state. In polycrystalline materials during the deformation process, a single grain heterogeneously breaks up into regions of cells, subgrains, deformation bands, and shear bands, which are high-energy regions [14], [15]. A significant driving force provided for recrystallization is by the higher stored energy regions in the microstructure.

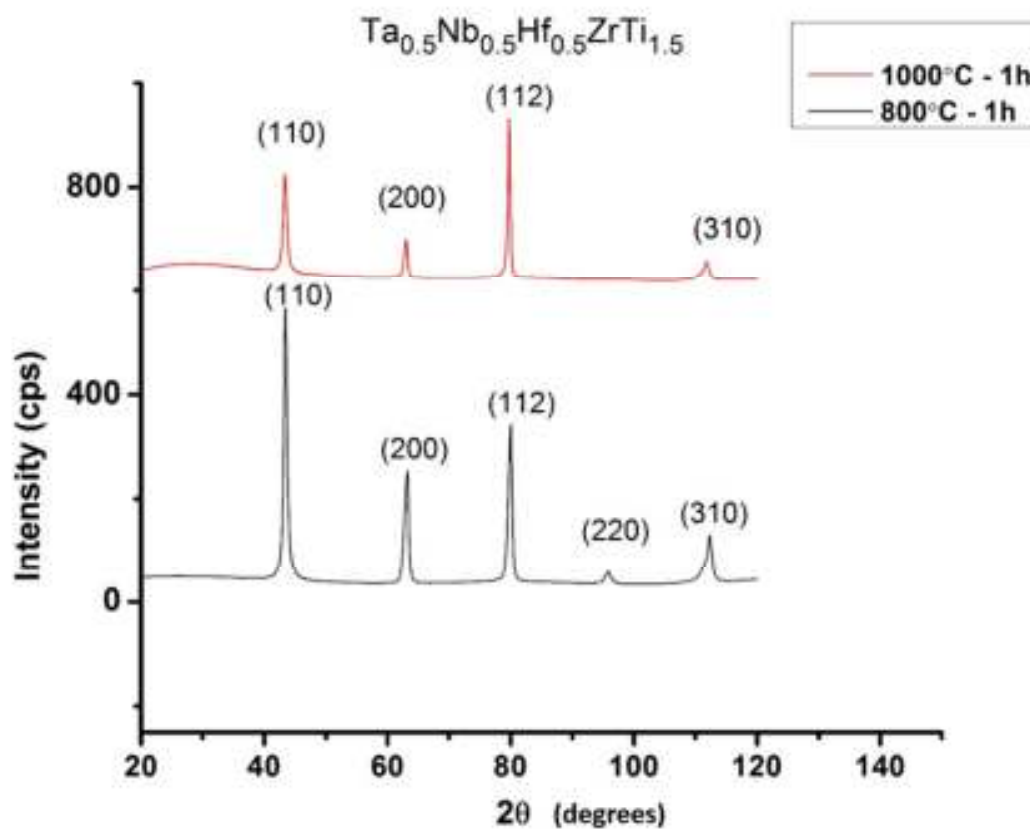
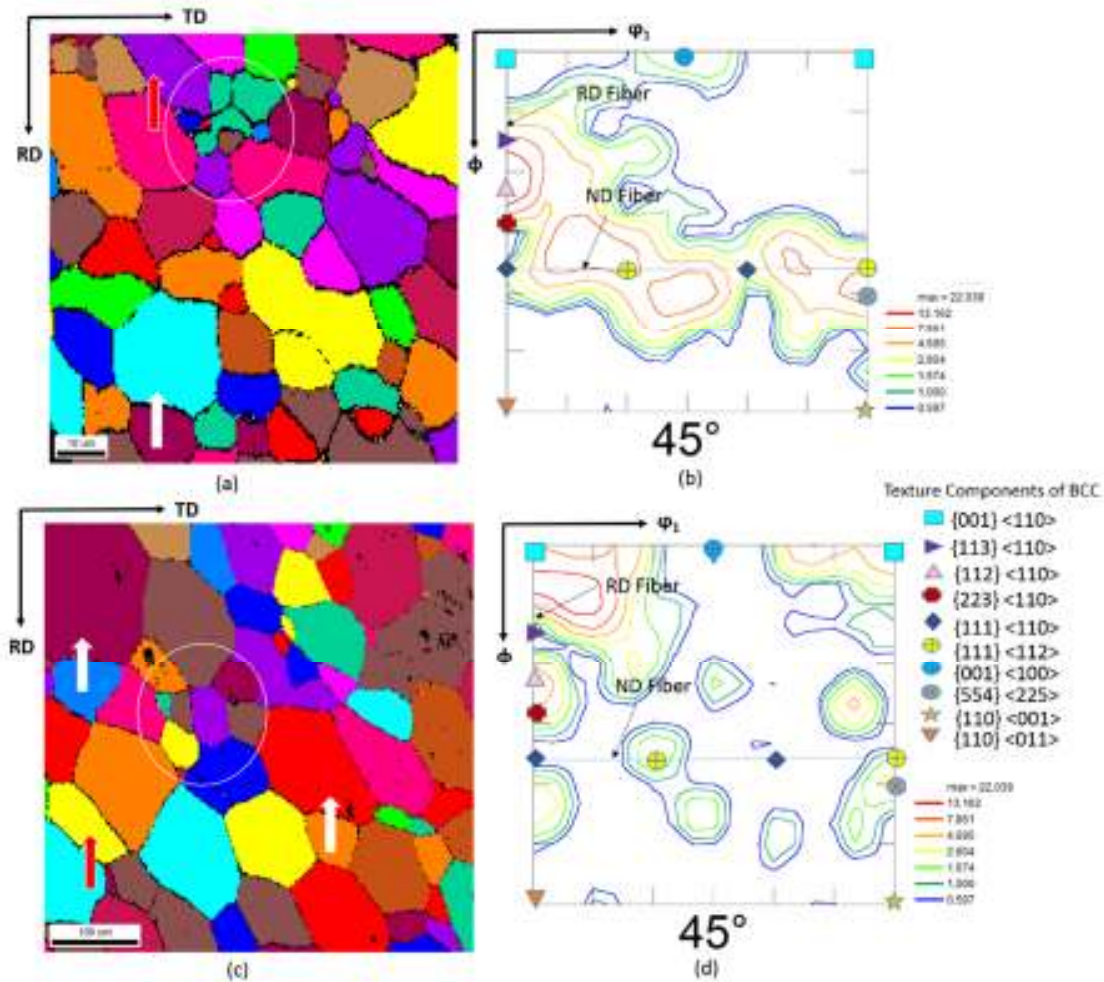


Fig 1. XRD graph of annealed temperatures at 800°C, 1000°C for 1h.

Fig 2 (a, c). EBSD unique grain color map and (b, d) $\phi_2 = 45^\circ$ sections of ODFs of annealed temperatures at 800°C, 1000°C for 1h.

The microstructure evolution in both annealed microstructures continues to show inhomogeneity or non-uniformity revealed by large preferentially grown recrystallized grains, and at the later stage of grain growth proceeds abnormal grain growth process. Thoroughly after completion of the recrystallization process grains involves abnormal grain growth [14], [15].

The texture is responsible for the directionality of properties; their origin and applications are a source of much scientific interest. However, the recrystallization texture develops when deformed materials are subjected to an annealing treatment. A typical deformation and recrystallization texture in BCC materials is represented by $\phi_2 = 45^\circ$ section of ODFs. Fig. 2 (b) EBSD results show the development of ND and RD fiber texture for the 800 °C annealed temperature, and eventually further annealed at higher temperature 1000°C shows the development of RD fiber and slightly

weak ND fiber texture in Fig. 2 (d). The recrystallization texture orientations generally follow the RD and ND fiber axis. Where the RD fiber texture with a $\langle 110 \rangle$ fiber axis parallel to the rolling direction and intensity maxima at $\{001\} \langle 110 \rangle$, $\{112\} \langle 110 \rangle$ and $\{111\} \langle 110 \rangle$, and ND fiber texture with the $\langle 111 \rangle$ fiber axis parallel to the sheet normal; the major components in this fiber texture have $\langle 110 \rangle$, $\langle 112 \rangle$ and $\langle 123 \rangle$ aligned with the rolling direction [15], [16]. The evolution of ND-fiber components after annealing is favored by recrystallization and its components usually undergo easy recrystallization due to their higher stored energy, which is the usual behavior of annealing texture formation BCC materials [15], [16].

3.2 Tensile Properties Development:

Fig.3. Shows the engineering stress-strain curves of the $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ alloy of cryo-rolled 90% and annealed temperatures at 800°C and 1000°C for 1h at a strain rate of 10^{-3} mm/sec carried out at room temperature. Severely cryo-rolled 90% percent exhibits yield strength 1010 MPa and tensile strength 1240 MPa, and ductility 8% percent at fracture. Next annealing treated at 800°C temperature for 1h samples consists slightly decreased strengths, but the elongation percentage is raised in comparison to cryo-rolled samples. The yield strength (YS), tensile strength (UTS), and elongation values are 995 MPa, 1170 MPa, and 10.9%, respectively is illustrated in (Fig.3). Further annealing temperature enhanced to 1000°C, and the tensile results show no significant change in yield strength about 980 MPa, but very small improvement in tensile strength (1210 Mpa) compared to previously annealed at 800°C temperature, and also there is no noticeable change in elongation 10.5% percentage (Fig.3).

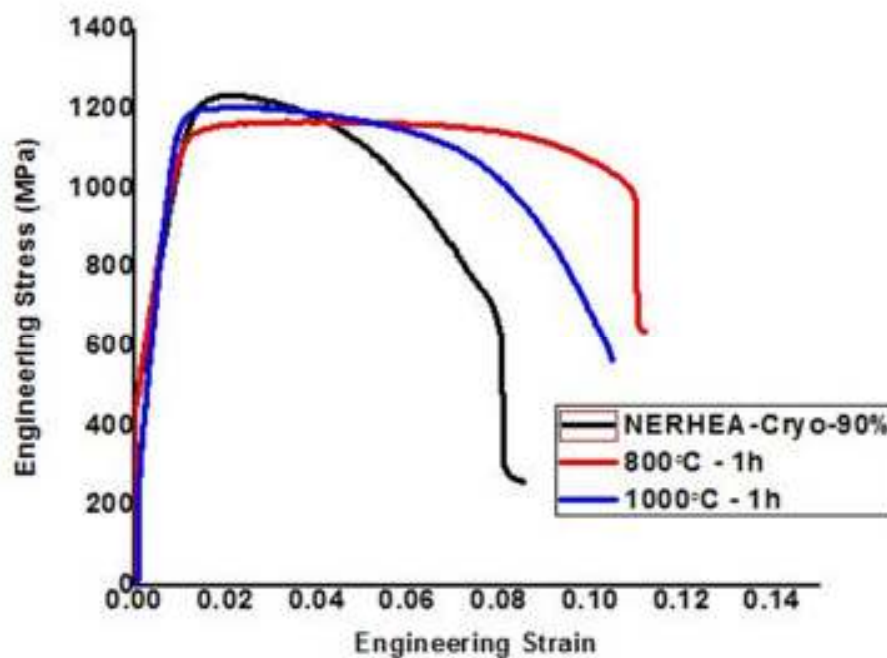


Fig 3. Tensile graph of cryo-rolled 90% and annealed temperatures at 800°C, (c)1000°C for 1h.

Table1: The average grain size of annealed temperatures.

	800 °C	1000 °C
Average Grainsize (μm)	08.98	53.42
Standard Deviation	05.08	34.93

But has a little higher elongation than the cryo-rolled sample. The slight high yield strength in the case of cryo-rolled 90% percent condition can be because of the small grain size induced during severe deformation via the cryo rolling process. The depletion of yield strength with an increase in annealing temperature is expected due to the recrystallized microstructure become coarse, and it is previously achieved in several investigations. The tensile strength is manifested by strain hardening, as earlier research studies on different metallic materials concluded that the increase in strain hardening increases tensile strength (UTS) [17], [18].

4. Conclusion:

The $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ RHEA was able to severely cryo-rolled. Both annealed temperatures 800°C and 1000°C exhibit a single-phase BCC structure. Moreover, annealed conditions revealed recrystallized inhomogeneity in the microstructure, regions containing relatively large recrystallized grains, and small grains regions. A comparatively coarse microstructure was observed for 1000°C annealed temperature than the 800°C annealed temperature because of a higher thermal energy effect at higher annealing. The recrystallized microstructures showed the development of ND fiber and RD fiber textures for both annealed temperatures. Development of significant tensile properties prevailed for the cryo-rolled and annealed conditions of $\text{Ta}_{0.5}\text{Nb}_{0.5}\text{Hf}_{0.5}\text{ZrTi}_{1.5}$ alloy.

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References:

- [1]. Yeh, J. W., Chen, S. K., Lin, S. J., Gan, J. Y., Chin, T. S., Shun, T. T., ... & Chang, S. Y. (2004). Nanostructured high-entropy alloys with multiple principal elements: novel alloy design concepts and outcomes. *Advanced Engineering Materials*, 6(5), 299-303.
- [2]. Murty, Bhagevatula Satyanarayana, Jien-Wei Yeh, Srinivasa Ranganathan, and P. P. Bhattacharjee. *High-entropy alloys*. Elsevier, 2019.
- [3]. Zhang, Y., Zuo, T. T., Tang, Z., Gao, M. C., Dahmen, K. A., Liaw, P. K., & Lu, Z. P. (2014). Microstructures and properties of high-entropy alloys. *Progress in Materials Science*, 61, 1-93.

- [4]. Lu, Z. P., Wang, H., Chen, M. W., Baker, I., Yeh, J. W., Liu, C. T., & Nieh, T. G. (2015). An assessment on the future development of high-entropy alloys: summary from a recent workshop. *Intermetallics*, 66, 67-76.
- [5]. Tsai, M.-H. and J.-W. Yeh, High-Entropy Alloys: A Critical Review. *Materials Research Letters*, 2014. 2(3): p. 107-123.
- [6]. Veeresham, M. "Development of Impressive Tensile Properties of Hybrid Rolled Ta_{0.5}Nb_{0.5}Hf_{0.5}Zr_{1.5} Refractory High Entropy Alloy." *International Journal of Mechanical and Materials Engineering* 15, no. 6 (2021): 267-271.
- [7]. Gao, M.C., Progress in High-Entropy Alloys. *Jom*, 2014. 66(10): p. 1964-1965.
- [8]. Zhang, Z., Mao, M. M., Wang, J., Gludovatz, B., Zhang, Z., Mao, S. X., ... & Ritchie, R. O. (2015). Nanoscale origins of the damage tolerance of the high-entropy alloy CrMnFeCoNi. *Nature communications*, 6, 10143.
- [9]. Gludovatz, B., Hohenwarther, A., Catoor, D., Chang, E. H., George, E. P., & Ritchie, R. O. (2014). A fracture-resistant high-entropy alloy for cryogenic applications. *Science*, 345(6201), 1153-1158.
- [10]. Pickering, E.J. and N.G. Jones, High-entropy alloys: a critical assessment of their founding principles and future prospects. *International Materials Reviews*, 2016. 61(3): p. 183-202.
- [11]. Li, Z., Pradeep, K. G., Deng, Y., Raabe, D., & Tasan, C. C. (2016). Metastable high-entropy dual-phase alloys overcome the strength–ductility trade-off. *Nature*, 534(7606), 227.
- [12]. Senkov, O. N., Wilks, G. B., Scott, J. M., & Miracle, D. B. (2011). Mechanical properties of Nb₂₅Mo₂₅Ta₂₅W₂₅ and V₂₀Nb₂₀Mo₂₀Ta₂₀W₂₀ refractory high entropy alloys. *Intermetallics*, 19(5), 698-706.
- [13]. Sheikh, S., Shafeie, S., Hu, Q., Ahlström, J., Persson, C., Veselý, J., ... & Guo, S. (2016). Alloy design for intrinsically ductile refractory high-entropy alloys. *Journal of Applied Physics*, 120(16), 164902.
- [14]. Humphreys, F.J. and M. Hatherly, in *Recrystallization and Related Annealing Phenomena* (Second Edition). 2004, Elsevier: Oxford.
- [15]. Verlinden, B., Driver, J., Samajdar, I., & Doherty, R. D. (2007). *Thermo-mechanical processing of metallic materials* (Vol. 11). Elsevier.
- [16]. Raabe, Dierk, and K. Lücke. "Rolling and annealing textures of bcc metals." In *Materials Science Forum*, vol. 157, pp. 597-610. Trans Tech Publications Ltd, 1994.
- [17]. Favier, Denis, Hervé Louche, Pauline Schlosser, Laurent Orgéas, Pierre Vacher, and Laurent Debove. "Homogeneous and heterogeneous deformation mechanisms in an austenitic polycrystalline Ti–50.8 at.% Ni thin tube under tension. Investigation via temperature and strain fields measurements." *Acta Materialia* 55, no. 16 (2007): 5310-5322.
- [18]. Stouffer, Donald C., and L. Thomas Dame. *Inelastic deformation of metals: models, mechanical properties, and metallurgy*. John Wiley & Sons, 1996.

Analysis of women participation in cassava value chain in Ugwunagbo Local Government Area of Abia State, Nigeria

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Abstract

Over the years, the demand for cassava products has increased drastically due to the increase in population. This calls for a need to bridge the gap in demand and supply through value addition. The study attempts to analyse women participation in cassava value chain. Results revealed a net return (Profit) of ₦ 15878, ₦ 33834 and ₦ 40320 for producers, processors, and marketers respectively, which implies that the business is profitable in the study area. The regression results for factors affecting the performance of producers, processors and marketers revealed an R^2 value of 0.5044, 0.9787, and 0.4341 respectively with age, credit and price as the significant variable influencing the performance of producers and marketers in the study area. The performance of processors was significantly influenced by age and price. Ordered probit regression used to evaluate the factors influencing women participation revealed a chi-square value of 12.90 with the coefficients of education, experience, income, credit amount and distance as the major factors influencing the level of participation in the study area. Also, the result revealed farming systems adopted as the major problem affecting producers and finance as the major problem affecting processors and marketers. The study recommends that Governments should invest in human capital development to promote the awareness and participation in cassava production and marketing. Also, the significant variables such as age, credit and price should be taken into consideration in policy issues.

KEYWORDS: Women, Cassava, Participation.

1.1 Background Information

Agriculture remains one of the pillars of Africa's economic, social and rural development. About 70% of Africans and roughly 80% of the continent's poor people live in rural areas and depend mainly on agriculture for their livelihood (Kinkingninhoun-Medagbe, 2014). Cassava, which is a commodity of interest, is gradually becoming the most important crop in Nigeria, not because of output only but the numerous uses and potentials derivable from this commodity (Knipscheer *et al*, 2007; NAERLS, 2009; Okoye, 2010).

In Nigeria, Cassava is grown in almost all the states and thrives in all the geopolitical zones. However, Nigeria is the largest cassava producer in the world; its production is three times more than Brazil and almost double the production of Indonesia and Thailand (IITA, 2004).

The role of women in agricultural production in Nigeria can never be over emphasized as women play important roles as producers of food, managers of natural resources, income earners, and caretakers of household food and nutrition security. Giving women access to physical and human resources could contribute to increase in agricultural productivity. Various researches conducted on the contribution of women to agricultural development in the country (Amali, 1988; Auta *et al.*, (2000) suggest that women contribution to the farm work is as high as between 60 and 90% of the total farm task performed. Also, women play central role in cassava production, processing and marketing, contributing about 58 per cent of the total agricultural labour in the southwest, 67 per cent in the southeast and 58 per cent in the North central zones Nigeria (Partnership Initiative in the Niger Delta, 2011). Despite the dominant and important role women play in agricultural production in the country, they are hardly given any attention in the area of training and/or visitation by extension agents with improved technologies (Damisa, 2007).

The value chain and utilization of cassava has been given prime attention by government and other stakeholders. More realistically value chain in cassava industry entails converting fresh roots into high quality cassava flour (HQCF), starch, sweeteners, dried chips, high quality meal (garri and fufu), and fuel ethanol which will increase income of farmers and enable them get maximum benefit from crop production. Therefore, evaluation of cassava value chain is critical for understanding the marketing system, their relationships, the participation of different actors and the main constraints that limit the growth of the enterprise as well as competitiveness of smallholder farmers.

The demand for cassava products is on the increase as Nigeria's population continues to grow rapidly without control. Bridging the rapidly increasing demand and supply gap in cassava processing and marketing calls for value addition as the products are being processed. So far, there is little quantitative and qualitative information focusing on analysis of women participation in cassava value chain. Therefore, aims to ascertain the factors affecting the profitability and cost and returns analysis of cassava along the value chain, factors influencing woman participation in cassava value chain as well as the constraints faced by producers, processors and marketers in the study area.

2.0 Research Methodology

2.1 Scope of the Study

This study was conducted in Ugwunagbo Local Government Area of Abia State. Ugwunagbo has an area of 108 km² and a population of 97,710 at the 2006 census (NPC, 2006). The area is located on the geographical coordinate of 4°59' North and 4°53' North latitude and 7°19' West and 32°08' West. Ugwunagbo have little deposit of crude oil which can be found in Obuzo. It also has vast cities like Obegu, Ngwayiekwe, Ihie, Asa-Umunka and so on. Ugwunagbo has a total of 28 communities. Its humid tropical ecology is characterized by two distinct seasons, namely, the dry season, which starts from November to late March and the rainy season, which starts from April to October. The general vegetation consists of woodland savannah in the northern part of the zone and mangrove forests in the deep Niger Delta area (Onyeneke and Madukwe, 2010). Farming is the predominant

occupation of the people in the area, majority of who are small-holder farmers. The farmers are primarily involved in food production and animal husbandry such as poultry, sheep, goat and grass cutter rearing. Major food crops cultivated include cassava, maize, yam, plantain, banana and vegetables. The farmers practice mixed farming as well as mixed cropping among which are cocoyam/maize/vegetable/cassava and cocoyam/maize. Some farmers also practices both crop and livestock i.e mixed cropping.

2.2 Sampling Technique

A multi-stage sampling technique was used to select 90 respondents from the population consisting of cassava women farmers, processors and marketers. Firstly, three (3) communities in Ugwunagbo Local Government Area were randomly selected. Secondly, (2) villages from each of the communities was selected. Finally, fifteen (15) women respondents (comprising of 5 raw cassava tuber marketers, 5 cassava processors and 5 garri marketers) were selected. This gave a total of ninety (90) women respondents for the study area.

2.3 Data Collection

Primary data was collected using a well structured questionnaire which was administered to women farmers in the study area. The questionnaire was designed to capture socioeconomic characteristics of women involved in cassava value chain, cost and return associated with cassava value chain products; factors affecting profitability of cassava value product along the value chain, level of women participation in cassava value chain in Ugwunagbo and the factors influencing level of participation of women in cassava value chain.

2.4 Data Analysis

Data Collected was analysed using different statistical tools to achieve the various objectives. Objective (i), (ii) and (v) were analysed using descriptive statistician tools (such as frequency, percentage and mean) while objective three (iii) which entails to estimate cost and return associated with cassava value chain products was analyzed using net income analysis, specified as follows;

$$NR = TR - TC \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (3.1)$$

$$TR = PQ$$

$$TC = TVC + TFC$$

NR = Net return,

TVC = Total Variable Cost,

TFC = Total Fixed Cost,

TC = Total Cost,

Q = Quantity of product sold,

P = Prevailing market price of the product.

Objective four which entails to estimate the factors affecting profitability of cassava value product along the value chain (Raw tuber seller, processors, marketers, ordinary Least Square (OLS) multiple regression technique was used. The model is as specified below.

$$Y=f(X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8,X_9) \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (3.2)$$

Where

Y= Net returns (Naira)

X₁=Age in (years)

X₂= Education (year)

X₃= Experience (years)

X₄= Household size (number)

X₅=Amount of credit (naira)

X₆=Storage cost (naira)

X₇=Price of cassava value added product (naira)

X₈=Transportation cost (naira)

X₉= Market charges (Naira)

Objective six (vi) which entails to examine the factors influencing level of participation of women in cassava value chain was achieved using ordered probit model. The model is specified in its explicit form thus;

$$\tilde{y} = N'\beta + \varepsilon \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad -3.3$$

Where N' and β are standard variables and parameter matrices, and ϵ is a vector matrix of normally distributed error terms. Obviously, predicted grades (\hat{y}) are as follows; $\hat{y}_{\text{ordered probit}}$

(3 = daily, 2 = weekly, 1 = monthly)

$$N_1 = \text{Age (Years)}$$

N_2 = Business experience (years)

N_3 = Level of education (number of years spent in formal schooling)

N_4 = Extension contact (number of visits in a year)

$$N_5 = \text{Amount of credit (Naira)}$$
$$N_6 = \text{Farm income (naira)}$$

N_7 = Distance to market (Km)

ϵ_i = Error term distributed across observations and is normalized with the mean and variance of zero and one.

3.0 Results and Discussion

3.1 Cost and return associated with cassava value chain

ITEM	PRODUCERS	PROCESSORS	MARKETERS
Selling price	1020	1984	2200
Purchase price /production cost		1020	1020
Quantity sold	18.46 bags	19 bags	19.2 bags
Total revenue	18717	37696	42240
Transportation cost	379	495	376
Storage cost	286	402	426
Loading and offloading	105	310	258

Marketing charges	1000	1921	430
Total variable cost	1770	3128	1490
Total fixed cost	1069	734	943
Total cost	2839	3862	1920
Net income	15878	33834	40320

Source: Field survey, 2019

The result in Table 3.1 shows average monthly revenue of about ₦18, 717, ₦ 37,696 and ₦ 42,240 for producers, processors and marketers respectively. The total variable cost was ₦1770, ₦3128.71, and ₦1490 for producers, processors and marketers respectively. The total fixed cost was ₦ 2839, ₦734 and ₦ 943 for producers, processors and marketers respectively in the study area. The net return (Profit) was ₦ 15878, ₦ 33834 and ₦ 40320 for producers, processors, and marketers respectively. This shows that the three products marketers had the highest returns and the most profitable in the study area.

3.2 Factors Influencing Profitability of Cassava along the Value Chain

3.2.1 Factors Influencing Profitability of Producers

Table 3.2. Regression analysis on determinants of factors affecting performance of producers

Variables	Linear	Exponential	Semi log (+)	Double log
Intercept	-15021.68 (-1.80)*	6.118429 (3.34)***	-146630.2 (-3.32)***	1.010893 (0.10)
Age (X ₁)	291.6555 (2.56)**	0.057454 (2.30)**	12222.53 (2.30)**	2.311414 (1.99)*
Education (X ₂)	2112.678 (1.90)*	0.506058 (2.07)*	4435.529 (1.49)	1.09209 (1.68)
Experience (X ₃)	-113.6812 (-0.59)	-0.0096493 (-0.23)	-815.425 (-0.51)	-.0432975 (-0.12)
Household size (X ₄)	72.73553 (0.35)	0.0042479 (0.09)	981.1817 (0.76)	0.0777045 (0.28)
Credit (X ₅)	0.0204771 (1.42)	3.09E-06 (0.98)	302.1092 (1.79)*	0.536719 (1.46)
Storage cost (X ₆)	-3.485195 (-1.14)	-0.0009409 (-1.40)	-70.54276 (-0.28)	-.0465381 (-0.85)
Price (X ₇)	11.32829 (2.33)**	-0.0007671 (-0.72)	15767.59 (2.89)***	-.2807126 (-0.24)
Transportation cost (X ₈)	-1.908914 (-0.73)	-0.0001631 (-0.29)	-213.2245 (-0.72)	-.0167702 (-0.26)
R ²	0.4910	0.3634	0.5044	0.3864
F-ratio	2.53**	1.50	2.67**	1.65

Source: Field survey data, 2019.

Figure in parenthesis are the t-ratio.

*, **, ***= Significant at 10%, 5% 1%, respectively.

Table 3.2. shows the regression results for factors affecting performance of producer in the study area. The choice of appropriate functional form for this study was chosen based on the economic, statistical and econometric criteria. Based on the criteria stated above semi log functional form was chosen as the lead equation. From the semi log functional form result, R^2 value of 0.5044 implies that the specified explanatory variables explained about 50.44% of the total variables in profit. This means that the remaining 49.56% was loss due to error or variables not specified in the model. The F-statistic of 2.67 was statistically significant at 1% probability level, indicating that R^2 is significant and this indicates that the equation has goodness of fit.

The significant variables include age, credit and price. Age was statistically significant at 5% and positively related to Y (Net returns) and it has a positive coefficient. This implies that as Age increases, the net returns of the producers also increases. Age may provide an indication, all things being equal, of the experience or knowledge of the respondents over the years on cassava production and how to overcome inherent challenges and problems so as to maximize output. This is in line with Afolabi (2009), who obtained positive and significant coefficient in their different studies. More so, increased age is associated with more responsibilities, marriage, caring for children and expanded scope of dependants could become a source of respite by ensuring continuity in market engagement. (Nnadi and Akwiwu, 2005).

Credit was statistically significant at 10% and positive related to producer net return. This implies that the credit amount significantly influenced the net return of the producer. The positive sign of the coefficient shows that as the credit as increased the return of the marketers increased and vice versa. This is in line with a *priori* expectation and may be due to the fact that credit obtained by the producer was channelled into other use. Furthermore, price of product was significant at 1% and positively related to the net return of producer. An increase in the price of product leads to an increase in net return of the producer.

3.2.2 Factors Influencing Profitability of Processor

Table 3.3. Regression analysis on determinants of factors affecting performance of Processor

Variables	Linear (+)	Semi log	Exponential	Double log
Intercept	11708.71 (1.70)	-200573.3 (-3.71)***	9.958928 (34.46)***	4.323962 (4.40)***
Age (X ₁)	-181.8682 (-1.92)*	-11465.41 (-1.33)**	-.0026661 (-0.67)	-.2728889 (-1.74)*
Education (X ₂)	-292.2598 (-0.34)	-1971.089 (-0.42)	-.0076539 (-0.21)	-.0154213 (-0.18)
Experience (X ₃)	-149.7552 (-1.18)	-935.7129 (-0.36)	-.0141034 (-2.64)**	-.0690837 (-1.45)
Household size(X ₄)	-121.4622 (-0.58)	-693.8845 (-0.27)	-.0068684 (-0.79)	0.0011162 (0.02)
Credit (X ₅)	0.0009154 (0.08)	101.1054 (0.41)	-4.99E-07 (-1.06)	-.0004099 (-0.09)
Storage cost (X ₆)	-6.260089 (-1.41)	-1110.78 (-0.38)	-.0001524 (-0.82)	-.0639537 (-1.22)
Price (X ₇)	20.72265 (22.87)***	43676.69 (10.92)***	0.0004756 (12.48)***	1.111232 (15.27)***
Transportation cost(X ₈)	2.877093 (0.87)	-525.4067 (-0.19)	0.0001231 (0.89)	0.032952 (0.63)
Market charges (X ₈)	-.8220708 (-0.83)	-200573.3 (-0.89)	-.0000234 (-0.56)	-.1078745 (-1.29)
R ²	0.9787	0.9250	0.9367	0.9580
F-ratio	102.34***	27.41***	32.90***	50.73***

Source: Field survey data, 2019.

Figure in parenthesis are the t-ratio.

*, **, ***= Significant at 10%, 5% 1%, respectively. + = lead Equation

Table 3.3 shows the regression results for factors affecting performance of processors in the study area. The choice of appropriate functional form for this study was chosen based on the economic, statistical and econometric criteria. Based on the criteria stated above linear functional form was chosen as the lead equation. From the linear functional form result, R² value of 0.9787 implies that the specified explanatory variables explained about 97.87% of the total variables in profit. The F-statistic of 102.34 was statistically significant at 1% probability level, indicating that R² was significant and this implies that the equation has goodness of fit.

The significant variables include; age and price. Age was statistically significant at 10% and negatively related. This implies that as age increases, the net returns of the processor decreases. The implication of this finding is that, as the processors advance in age, their net return decrease and vice versa. Age may provide an indication, of the experience or knowledge the respondent may have gained over the years on cassava processing (all things being equal). However, Bassey *et al* (2013) posited that processor at their youthful age promote efficiency. Also price of product was significant

at 1% and positively related to the net return of producer. This implies that N1 increase in the price of product leads to 20.72 increases in net return of the processors.

3.2.3 Factors Influencing Profitability of Marketers.

Table 3.4. Regression analysis on determinants of factors affecting performance of marketers

Variables	Linear	Exponential	Semi log	Double log (+)
Intercept	-14895.39 (-1.72)	8.80624 (29.81)***	-329165.1 (-6.53)***	-1.798025 (-1.60)*
Age (X_1)	220.7834 (1.45)	0.008844 (1.70)	5295.987 (0.56)	0.3423945 (1.63)*
Education (X_2)	-25.172 (-0.1)	0.0343931 (0.59)	-3371.544 (-0.59)	-0.0305027 (-0.24)
Experience (X_3)	-25.53708 (-0.10)	-0.0062246 (-0.73)	1319.352 (0.56)	0.0079466 (0.15)
Household size (X_4)	31.76194 (0.03)	-0.0400188 (-1.19)	2593.037 (0.66)	-0.0551679 (-0.63)
Credit (X_5)	-1403.185 (-0.42)	-0.0445104 (-0.39)	-499.1556 (-0.12)	-0.0249961 (-2.70)**
Storage cost (X_6)	-3.527566 (-0.56)	-0.0000328 (-0.15)	-2130.697 (-0.67)	-0.0369473 (-0.52)
Price (X_7)	4.717373 (13.02)***	0.0001422 (11.50)***	39800.07 (10.58)***	1.254956 (14.93)***
Transportation cost (X_8)	-2.560005 (-0.45)	-0.0000448 (-0.23)	-992.4918 (-0.36)	-0.0340794 (-0.55)
R^2	0.9124	0.8895	0.8659	0.9273
F-ratio	27.35***	21.12***	16.94***	33.49

Source: Field survey data, 2019.

Figure in parenthesis are the t-ratio.

*, **, ***= Significant at 10%, 5% 1%, respectively. + = lead Equation

Table 3.4 shows the regression results for factors affecting performance of marketers in the study area. The choice of appropriate functional form for this study was chosen based on the economic, statistical and econometric criteria. Based on the criteria stated above linear functional form was chosen as the lead equation. From the double functional form result, R^2 value of 0.9273 implies that the specified explanatory variables explained about 92.7% of the total variables in profit.

Age was statistically significant at 10% and positively related. This implies that as age increases, the profit of the marketer increase. The implication of this finding is that as the Marketers advance in age, their net return increase and vice versa. Onyebinama (2004) noted that the age of

a business manager is likely to influence his attitudes, motivation, behavioural patterns and capacity to adopt new innovation and his sensitivity to risk. Older marketers seem to be less receptive of innovative ideas and this affects their efficiency negatively. Also, old marketers are not always able to do a lot by themselves and may need to employ helps and this increases overhead cost which in turn, affects profit negatively.

Credit was statistically significant at 10% and negative related to marketer's net return. This implies that the credit amount significantly influenced the net return of the producer. The negative sign of the coefficient shows that as the credit increased, the return of the marketers decreased and vice versa. This is against *a priori* expectation and might be due to the fact that credits obtained by the marketers were channelled into other use.

Also price of product was significant at 1% and positively related to the net return of marketers. This implies that ₦1 increase in the price leads to 1.254956 increase in net return of the marketers.

3.3.0 Factors Influencing Level of Participation of Women In Cassava Value Chain

Table 3.5 Ordered probit regression on factors influencing level of participation

Variables	Coefficients	Std. Error	z-value
Age	-0.0217	0.037	-0.58
Experience	0.123	0.069	1.77*
Education	0.731	0.426	1.72*
Extension	0.351	0.425	0.52
credit amount	8.68e-06	0.689	1.79*
Income	0.000	4.84e-06	1.90**
Distance	-0.377	0.000	-2.17**
LR $\chi^2(9)$	12.90		
Prob> chi ²	0.0747		
Pseudo R ²	0.2311		
log likelihood	-19.713		
Number of observation			

Source: Field Survey, 2019 *, **, *** denotes 10%, 5% and 1% significant respectively

Table 3.5 shows the ordered probit regression factors influencing level of Women participation in cassava value chain. The result value of chi-square was 12.90, significant at 1% level, Pseudo R² was 24.65% and log likelihood was -19.712, this shows strong explanatory power of the model. Also, it revealed that the coefficient of experience.

Education, credit amount and income labour were significant factors influencing level of participation of women in cassava value chain

The coefficient of experience and education were positive and significant at 10%. This implies that increase in the any of these variables will increase level of participation. In other words, as the respondent improves on her educational level, she becomes influenced to participate in agricultural production. This is partly caused by of the exposure of the woman on modern farming techniques accruing from education. Also Ogumbameru *et al.* (2004) reported that highly educated farmers can get information on modern agricultural production techniques from a wide range of sources such as extension agents, electronic or print media, internet etc. Better education has the effect of enabling households access and conceptualize information on improved participation and other related issues capable of enhancing their income (Apata *et al.*, 2010).

The coefficient of income and amount of credit was positive and significant at 10%. This implies that increase in amount of credit will increase level of participation. The implication of lack of adequate access to credit has significant negative consequences for aggregate output (Diagne and Zeller, 2011). Improved access to credit will help poor women participate effectively and this will raise their living standards. Access to credit has the capacity to transform the poor through acquiring productive capital, which improves their capacity to generate income (Diagne and Zeller, 2011).

The coefficient of distance was negative and significant at 1%. This implies that increase in the distance will reduces level of participation. This implies that participation decreases with increase in distance and vice versa.

3.4.0 Constraints Faced By the Producers, Processors and Marketers in the Area.

Table 3.6: Distribution of respondents based on the problems encountered

Problems faced	Producer	Processor	Marketers
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Lack of processing facilities	3.77	3.88	3.65
Lack of proper Education	2.88	2.99	2.76
Lack of Storage Facilities	2.57	2.68	2.45
Inaccessibility to extension staff	3.78	3.89	3.66
Shortage of labour	2.87	2.98	2.75
Lack of land ownership right	2.88	2.99	2.76
Lack of credit	2.97	3.08	2.85
Inadequate Finance	3.93	4.04*	3.99*
Shortage of Farm Inputs	3.01	3.12	2.89
Low Level of Infrastructure	3.16	3.30	3.06
Low Government support	2.24	3.18	3.87
Scarcity/shortage of cassava	3.96	3.91	3.00
Limited capacity for expansion	3.6	3.16	3.16
Lack of access to improved technologies	3.66	3.87	3.91
Poor farming systems	4.01*	3.49	3.26
Clustered mean	3.23	3.32	3.15

Source: Field survey, 2019. Decision: $\bar{x} > 3.0$ influential factors $\bar{x} \leq 3.0$ not influential

Table 3.6 shows the distribution of cassava product marketers according to their problems. From the distribution of the respondents based on the problems encountered by respondents in the study area, The result shows that the three major problems faced by producer were farming systems, inadequate finance and shortage of extension staff. Type of farming (Extensive farming, Intensive farming, Small scale farming and large scale farming), adequate financial and more extension workers determine the intensity of production among the cassava farmers.

Also the producers are faced with problems of low government support, lack of access to improved technologies and inadequate finance. Financing of marketing is plagued with a number of problems such as the problem of over dues, unsatisfactory credit conditions, increasing malpractices and corrupt credit culture etc.

4.0: Conclusion and Recommendation

The findings of this study, led to the conclusion that cassava production, processing and marketing in the area was profitable. Secondly age, credit and price were supported factors affecting the performance of the producer in the area, also age and price were significant variables influencing the profit of the processors in the area while age, credit and price was statistically significant variable influencing profit of the marketers. Furthermore, education, experience, income, credit amount and distance were factors influencing level of participation in the area. These led to the following recommendations;

1. There is a need for Government to invest in human capital in the cassava production, processing and marketing, educate and create awareness on the benefits of cassava production, processing and marketing.
2. Since credit was a significant factor influencing the profit of the producer, the study therefore recommends that micro- credit institutions should provide credits to farmers at affording rate. Therefore the government could also assist through relaxation of any stringent guidelines in securing for formal credit.
3. The significant variables such as age, credit and price as well as the problems should be taken into consideration in policy issues.

References.

- Amali .E. (1989).The role of women in agricultural development process.Development studies review, 3(1-2), 52-60.
- Auta, S.J., S. Abubakar, Z. and R. Hassan, 2000. An assessment of the contribution of women to family farming in North Eastern Nigeria. A Research Report Submitte to Nears/Abu Zaria, September, 2000.
- Damisa, M.A.,(2007) Household typology based analysis of livelihood strategies and poverty status in the Sudan Savannah of Nigeria: Baseline conditions. Learning Publics J. Agric. Environ. Stud., 2(1): 146-160. Eboh, E.C., 2009. Social and Economic Research: Principles and Methods. 2nd Edn., African Institute for Applied Economics, Enugu, Nigeria, pp: 262.

IITA, (International Institute for Tropical Agriculture) (2004a) Nigerian Cassava Industry Statistical hand book.

International Institute of Tropical Agriculture (IITA) (2004). “*Nigeria’s Cassava Industry*” Statistical Handbook. Partnership Initiative in the Niger Delta. A report on cassava value-chain analysis in Niger Delta; 2011. Available: www.pindfoundation.net/wp-content/plugins/Cassava-Value-Chain-Analysis.pdf (Retrieved on 26 June 2013)

Kinkingninhoun-Medagbe, Florent Mahoukede & Diagne Aliou., Patrice Y. Adegbola (2014) “Impact of NERICA Adoption on Productivity and Income in Benin: Is There Gender Difference, AETA, Gender differential impact of NERICA rice varieties adoption in Benin, 2014.

Knipscheer H, C Ezedinma, P. Kormawa, G. Asumugha, K. Makinda, R. Okechukwu, and A. Dixon (2007). Opportunities in the industrial cassava market in Nigeria. International Institute of Tropical Agriculture, Ibadan.

Nigeria. National Population Commission (NPC) (2007). A Blueprint of 2006 National Census Abuja, Nigeria.

Okoye, B.C (2010) Analysis of market participation among small-holder cassava farmers in response to transportation costs in South East Nigeria. Unpublished Ph.D thesis, Agricultural Economics department, MOUAU, Umudike.

Onyebinama, U.A.U. (2004). Farm business management for smallholder farm firms in Nigeria. Alphabet Nigeria Publisher, Owerri, Imo state, Nigeria.

Onyeneke R. U. and Madukwe D. K (2010). Adaptation measures by crop Farmers in the Southeast rainforest zone of Nigeria to climate change. Science World Journal 5(1).

Akwiwu, C.D., C.U. Nwajiuba and F.N. Nnadi, 2005. Harnessing the potentials of youths for rural household food security in Nigeria. Anim. Prod. Res. Adv., 1: 104-110.

Mixotrophic Growth as a Tool for Increasing PHA Production in Cyanobacteria

Sedrlova Z., Slaninova E., Fritz I., Daffert C., Obruca S.

Keywords— co-polymer, cyanobacteria, PHA, *Synechocystis*

Abstract— Cyanobacteria are ecologically extremely important phototrophic gram-negative bacteria capable of oxygenic photosynthesis. They synthesize many interesting metabolites such as glycogen, carotenoids, but the most interesting metabolites in are polyhydroxyalkanoates (PHA). The main advantage of cyanobacteria is the fact they do not require costly organic substrate and, oppositely, cyanobacteria can fix CO₂. PHA serve primarily as carbon and energy source and occur in form of intracellular granules in bacterial cells. It is possible, PHA help cyanobacteria to survive stress conditions, since increased PHA synthesis was observed during cultivation in stress conditions. PHA are microbial biopolymers which are biodegradable with similar properties as petrochemical synthetic plastics. Production of PHA by heterotrophic bacteria is expensive, for price reduction waste materials as input material are used. Possitely, cyanobacteria principally do not require organic carbon substrate since they are capable of CO₂ fixation. In this work we demonstrated that stress conditions lead to the highest obtained yields of PHA in cyanobacterial cultures. Two cyanobacterial cultures from genera *Synechocystis* were used in this work. Cultivations were performed either in Erlenmayer flask or in tube multicultivator. Multiple stressors were applied on cyanobacterial cultures, stressors include PHA precursors. PHA precursors are chemical substances and some of them does not occur naturally in the environment. Cultivation with the same PHA precursors in same concentration led to 1,6x higher amount of PHA when multicultivator was used. The highest amount of PHA reached the 25 % of PHA in dry cyanobacterial biomass. Both strains are capable of co-polymer synthesis in presence of its structural precursor. The composition of co-polymer differs in *Synechocystis* sp. PCC 6803 and *Synechocystis salina* CCALA 192. *Synechocystis* sp. PCC 6803 cultivated with γ -butyrolakton accumulated co-polymer of 3-hydroxybutyrate (3HB) and 4-hydroxybutyrate (4HB) the composition of co-polymer was 56 % of 4HB and 44 % of 3HB. The total amount of PHA as well as yield of biomass was lower than in a control due to the toxic properties of γ -butyrolakton.

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Characterization of Cyanobacteria as Polyhydroxybutyrate Producer

Slaninova E., Cernayova D., Sedrlova Z., Mrazova K., Sedlacek P., Nebesarova J., Obruca S.

Abstract — Cyanobacteria are Gram-negative prokaryotes belong to a group of photosynthetic bacteria. In the comparison with heterotrophic microorganisms, cyanobacteria utilize atmospheric nitrogen and carbon dioxide without any additional substrates. This ability of these microorganisms could be employed in biotechnology for production of bioplastics, concretely polyhydroxyalkanoates (PHAs) which are primarily accumulated as a storage material in cells in the form of intracellular granules.

In this study, two cyanobacterial cultures from genera *Synechocystis* were used, namely *Synechocystis* sp. PCC 6803 and *Synechocystis salina* CCALA 192. There were optimized and used several various approaches including microscopic techniques such as Cryo-scanning electron microscopy (Cryo-SEM) and transmission electron microscopy (TEM) and fluorescence lifetime imaging microscopy using Nile red as fluorescent probe (FLIM). Due to these instrumental techniques, morphology of intracellular space and surface of cells were characterized. Next group of methods which were employed were spectroscopic techniques such as UV-Vis spectroscopy measured in two modes (turbidimetry and integrating sphere) and Fourier transform infrared spectroscopy (FTIR). All these diverse techniques were used for detection and characterization of pigments (chlorophylls, carotenoids, phycocyanin etc.) and PHAs, in our case poly(3-hydroxybutyrate) (P3HB). To verify results, gas chromatography (GC) was employed, concretely for determination of amount of P3HB in biomass. Cyanobacteria was also characterized as polyhydroxybutyrate producer by flow cytometer which could count cells and at the same time distinguish cells including P3HB and without P3HB due to fluorescent probe called BODIPY and live/dead fluorescent probe SYTO Blue. Based on the results, P3HB content in cyanobacteria cells was determined and also overall fitness of the cells.

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Keywords—Cyanobacteria, fluorescent probe, microscopic techniques, poly(3-hydroxybutyrate), spectroscopy, chromatography

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Evolutionary Engineering of Selected Polyhydroxyalkanoate Producing Strains to Biotechnologically Relevant Stressors

Novackova I., Chatrna V., Slaninova E., Sedlacek P., Porizka J., Kalina M., Samek O., Obruca S.

Abstract— Polyhydroxyalkanoates (PHA) offer auspicious alternative of traditional petrochemical plastics with suitable properties including biocompatibility and biodegradability. The most common and also the most studied candidate poly(3-hydroxybutyrate) [P(3HB)] represents material with properties which are not very favourable for further processing, because it is brittle, and its melting temperature is close to temperature of decomposition. This is the reason why emphasis is on the study of copolymers with wide potential of applications due to significantly different physicochemical properties such as different melting temperature, much lower crystallinity leading up to elasticity of materials and others. PHAs can be prepared chemically for instance via ROP (ring opening polymerization) but much more often they are synthesized by microorganisms, which serve as a storage of carbon and energy. Type of PHA is related with producing microorganism considering its metabolic apparatus, two main types represent scl-PHA (primarily P(3HB)) and mcl-PHA, when it also depends on source of carbon. Basic carbon sources the most often lead to production of homopolymers, but addition of precursors together with main carbon source can lead to production of various copolymers. Some of precursors can negatively affect growth and producing capability of microorganism which can be solved by methods of evolutionary engineering making producing strains to be more robust against effects of inhibitors. Approaches of evolutionary engineering serve as useful tools for obtaining of microorganisms with suitable characteristics on phenotype level (e.g. more effective growth, ability of utilization of different carbon sources, better productivity, etc.) without requirement for knowledge of genetic characteristics of microorganisms. Presence of inhibitor does not have to negatively affect growth of producing strain after adaptation process and moreover higher yield of copolymer can be obtained. That means that evolved microbial strains obtained during evolutionary engineering experiments could be used for production of PHA with required

properties for selected purposes. Two PHA producing strains have been selected for evolutionary engineering experiments. *Halomonas halophila* (CCM 3662), promising halophilic PHA producer, was exposed to acetic and levulinic acid, both representing microbial inhibitors commonly presented in hydrolysates of lignocellulosic biomass. Second selected strain was model producer of PHA *Cupriavidus necator* H16 (CCM 3726) also exposed to levulinic acid, to osmotic stress represented by presence of NaCl and finally to anthropogenic pollutant represented by copper ions. Multiple serial transfers of cell cultures in Erlenmeyer flasks after 48 hours were provided within adaptation experiments for more than 80 passages. Every passage has been basically characterized and selected preserved ones were also compared with wild-type strain considering potential of PHAs accumulation, effectivity of utilization of organic acids, testing of robustness, “fingerprint” of cells using Raman spectroscopy and others features.

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Keywords— *Cupriavidus necator* H16, evolutionary engineering, *Halomonas halophila*, polyhydroxyalkanoate.

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An Indigenous Education Policy as the Panacea for Africa's Development: The Nigeria Case Study

Oluwafemi Oni

Abstract— Education is the process by which any society through schools, colleges, universities and other institutions transmits its heritage (its accumulated knowledge, values and skills) from one generation to another. Nigeria was a colony of British imperialist until flag independence was granted on October 1st, 1960 and the conferment of a status of a Republic in 1963. Notwithstanding the divergent views held by scholars of History, it can be rightly argued that the contribution of Britain in the civilization process of Nigeria is an indelible milestone that propelled Nigeria's march from a primordial and classically primitive antecedent into continental and global political relevance. In pre-colonial times, education in Nigeria, although imparted through informal means, was very rich and teachers were very dedicated. The feet of the elders formed the classrooms and pupils were initiated into life and living majorly through proverbs and wise sayings. Education during the pre-colonial period up to the 1970's could be said to be organized. Unfortunately, the 1980's till the present Nigeria has witnessed the desecration of education. These problems affecting the nation's education sector are serious when we take into consideration the fact that government regulations guiding the education sector are mechanical guidelines, entirely lacking in a sound philosophical footing. School curriculum are lacking in content. The study of indigenous languages is gradually being phased out from the school curriculum. All the policy orientations affecting and regulating schooling are not properly organized or efficient in packaging the desired quality of education. Furthermore, in this age when the family, the basic and first social context for the child's socialization and training, has also been dislocated as both husband and wife enter into full-time occupations to make ends meet, the society now depends almost solely on the school as the social agent to prepare the child mentally, morally and socially to become a responsible citizen. It is no gainsaying that the contemporary Nigerian environment therefore is thus ill-equipped to prepare children qualitatively to achieve the goal of education of search for an understanding of the meaning and the purpose of life, and discovering the right way to live. Already the nation has begun to witness the effect of this situation, which includes lowering of values and morals, and students' involvement in violent and wicked acts besides meaningless intellectual orientation and ideas.

Keywords— education, colonialism, curriculum, indigenous.

Structure Analysis of Text-Image Connection in Jalayrid Period Illustrated Manuscripts

Mahsa Khanioushani

Abstract—Text and image are two important elements in the field of Iranian art, the text component and the image component have text is the factor in the formation of the image and they were closely related to each other. The connection between text and image is an interactive and two-way connection in the tradition of Iranian manuscript arrangement. The interaction between the narrative description and the image scene is the result of a direct and close connection between the text and the image, which in addition to the decorative aspect, also has a descriptive aspect. In the following article, the connection between the text element and the image element and its adaptation to the theory of Roland Barthes, the structuralism theorist, in this regard will be discussed. This study tends to investigate the question of how the connection between text and image in illustrated manuscripts of the Jalayrid period is defined according to Barthes theory. And what kind of proportion has the artist created in the composition between text and image? Based on the results of reviewing the data of this study, it can be inferred that in the Jalayrid period, the image has a reference connection and although it is of major importance on the page, it also maintains a close connection with the text and is placed in a special, special proportion. It is not necessarily balanced and symmetrical and sometimes uses imbalance for composition. This research has been done by descriptive -analytical method, which has been done by library collection method.

Keywords—Structure, Text, Image, Jalayrid, Painter

I. INTRODUCTION

THE interaction between art and literature in Iran has a long history, the artistic image created by the artist always appears next to literary texts. Text and image have a long-standing relationship with each other that has shaped the tradition of transcription in literature, which has both a decorative and a descriptive aspect. The arrangement of manuscripts with images created a platform for collaboration between the calligrapher and the painter so that the image would appear next to the text. The image is used both for the beauty of the page and to attract the audience, and for describing the subject and describing the narration, in order to convey the meaning of the text to the audience more easily. The element of text and the element of image are intertwined in two-way interaction, together creating a single whole that advances the story. The position of the text and the position of the image on a page of the illustrated manuscript are of particular importance. The location of the text and its relevance to the image, law, and various patterns in illustrated manuscripts create different historical periods in Iran. Examining the position of the text and the image and the relationship between these two visual elements on the page forms the basis of the forthcoming text. First, the structure of the visual elements of the text and image and their position in relation to each other are examined, then

the relationship and composition of these elements on the page are studied to obtain the legal pattern of each period and their similarities and differences. This research is based on Roland Barthes' theory about the relationship between text and image with a structuralism approach and comparative-analytical method and data collection is a library method. To answer these questions, how is the relationship between text and image defined in the illustrated manuscript of the Jalayrid period according to Barthes theory? And, what kind of proportion has the artist created in the composition between text and image? It is assumed that in the patriarchal period the place of the text in the illustrated version is of major importance, the image supports the text and they have a descriptive relationship with each other. But in the glossary period, the main importance is with the image, the image plays a major role on the page, and the text appears on the page to support the image, so they have a reference relationship.

II. PROCEDURE FOR PAPER SUBMISSION

The research method of this research is comparative-analytical with a structuralism approach. The process of analysis is from component to whole. First, the structure of the components is examined, such as the structure of the image and the structure of the text, and then we come to the structure of the whole page. The method of this research is qualitative. Data collection is done through library and internet collection. The images of the studied versions have been collected through an online database and the available library books have been used in describing and analyzing it. Examples of this research have been selected from the Jalayrid period. The selected illustrated copies of Jalayrid period are: Khajovi Kermani Divan, Garshasbnameh and Sultan Ahmad Jalayer Divan.

III. RESEARCH BACKGROUND

The relationship between text and image has always been of interest to structuralisms and linguists. Many studies on literature and linguistics have focused on the relationship between text and image, including Roland Barthes' book "Introduction to Structural Analysis of Narrative" (1977), which is itself structuralism and on the types of relationship between text and image. Is writing. The relationship between text and image has also been considered by experts in children's literature and illustration, including Golden in his book "Symbol of Narrative in Children's Literature" (1987), which outlines five divisions in the relationship between text and image in children's fiction books. Among the dissertations formed in this field, the following dissertations can be mentioned: In Izadi's dissertation "Analysis of the relationship

between text and image in the drawings of Khajovi Kermani Divan of Jalayeri school" (1397) And they only studied in Khajovi Kermani's paintings. Also in the famous dissertation entitled "Study of the relationship between text and image in the great patriarchal Shahnameh of Demot" (2013), the relationship between text and image in the patriarchal period and only in the great patriarchal Shahnameh has been studied. Prizadian's dissertation entitled "Study of the relationship between frame (frame) and narrative in the painting of the patriarchal era to the end of the Timurid era" (2015) examines the text between the text and the frame and the text box in the general structure of the illustrated manuscript page to the end of the era Timurid. In the meantime, the present article is a new study examining the relationship between text and image, which is a comparative study of illustrated versions based on Barthes' theory.

IV. THEORETICAL FRAMEWORK

A. Image

The image was the first mass media among humans. Man has known for thousands of years that he can convey his concepts through images. These images (visual language) gradually became illustrations with simple forms and then became phonetic and linguistic units and finally took the form of the alphabet (text) [5]. After inventing the line, humans also continued to use images to communicate. The image is always seen next to the text and uses the image to accelerate the transfer of its meaning. To examine the relationship between text and image, structuralists made various classifications, including Roland Barthes, who proposed three types of relationship between text and image. 1. Image reference. When the text supports the image. 2. Descriptiveness of the image. When the image supports the text. 3. Being similar. When they support each other equally [4]. Based on this definition, the illustrated manuscripts of Iran in the Jalayrid period are examined and the relationship between the text and the image and its pattern is studied on the page.

B. Jalayrid school layout

At the beginning of the decline of the Mongol patriarchs, a number of patriarchal generals led to independence, including the Al-Jalayer, who became the most powerful of all [22]. They made their capital the city of Baghdad and their artistic centers were the two cities of Baghdad and Tabriz, one of the most important sultans of which is Sultan Ahmad Jalayer [21]. "With the collapse of the Ilkhanate in 736 AH. Gradually, the areas under their control revolted, and in the meantime, Sheikh Hassan Jalayer dominated Iraq and Azerbaijan and founded the Al-Jalayr dynasty, which ruled until 813 AH" [11]. During the reign of Sultan Ahmad, art was very popular. He himself was a master in various arts such as painting, gilding and finishing, he wrote good poetry and was good at six calligraphies, and he also knew music and periods. He was a student of Master Abdolhai in painting [12]. As a result, a poetic and mystical atmosphere was established in the Jalayrid period, which was compatible with the nature of the artists and caused the development of their tastes and talents. Painting in this period is gradually freed from the domination of the text and occupies a full page, and

this issue is one of the progress of painting in this period and a sign of the importance of painting against the line [23].

C. Sultan Ahmad Jalayer's Divan

One of the illustrated books of this period is the Divan of Sultan Ahmad Jalayer, which was written by the order of Sultan Ahmad Jalayer in 804 AH and is now kept in the Smithsonian Museum in the private collection of Freer Washington. The Divan of Sultan Ahmad, written by Khajeh Mir Ali Tabrizi, has 337 pages" [1]. Nature and angel-like figures and ordinary human beings create very decorative borders for the effect. "This manuscript does not have a drawing, but the decorative margins of the eight images on the last page, including rural landscapes and flying angels, are depicted in gold and light blue" [7]. "Abd al-Hayy, the painter of this divan has embodied each of the seven valleys of Attar al-Tair logic in an independent design and has drawn them in the margins of the pages of this divan" [8].

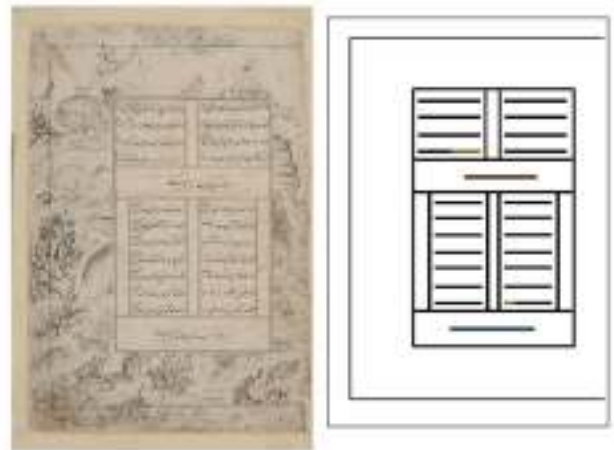


Fig. 1. Diwan of Sultan Ahmad. 9th century AH, Metropolitan

Fig. 1 is a page from the version of Sultan Ahmad Jalayer's Divan. This page also has a specific section. The page space is divided by creating boxes [2]. A vertical box surrounds the page of the paper and another vertical box is created in the heart, but this time the smaller box inside the larger box is for text and the text is written in the inner box. This inner box is also divided into several parts. The two vertical columns in which the text is placed, which is itself divided into two parts by a horizontal box, in which a bit is written, and also a horizontal box is placed at the end of the lines, in which a bit of the poem is also written, in a way. This evokes a headline [16]. The calligrapher makes his work space uniform by dividing different frames and also uses color differences in calligraphy and shows certain words with color distinction such as the word "Ahmad" which can indicate the patron of this version of "Sultan Ahmad" [3]. Be. The text is distinguished by dark blue and dark red in the headlines. Since Sultan Ahmad supports the preparation of this version, it can be concluded that the color difference in this name is to show its importance and specialness. As in the illustrated Qurans of this period, the word GOD was distinguished with a different color. "In some Qur'ans of the patriarchal period, among the verses wherever the name of God is mentioned, the word "Jalala" is used in a different color,

usually with a gold, white or ink pen. Red has been written or written in gold as a review of the golden canvas, or it has been written in a different line from the text" [12]. In these pages, the painter encounters a lot of space in the margins of the writings and He finds a large workspace for his paintings, which uses the utmost of this space, and it seems that even this is not enough for his freedom, and goes beyond his specified frame. Linear drawings with subtle and finite colors move delicately and freely from the main frame range specified for the image to the edges of the paper. You can easily see the painter's sense of freedom on this illustrated page. Linear images without deep color have written landscapes all over the page. A style that is known as the style of poetry in later periods and painters continue it in later periods. On this page the text is not dominant, the image is surrounded by text. On the other hand, the image does not dominate the text and only has the margin of the text. So it can be concluded that the image and the text appear equally together and support each other equivalently. As a result, based on Bart's theory, they have an identical relationship with each other. The text and the image are placed side by side in the same way, as they are interdependent, they can also exist independently of each other.

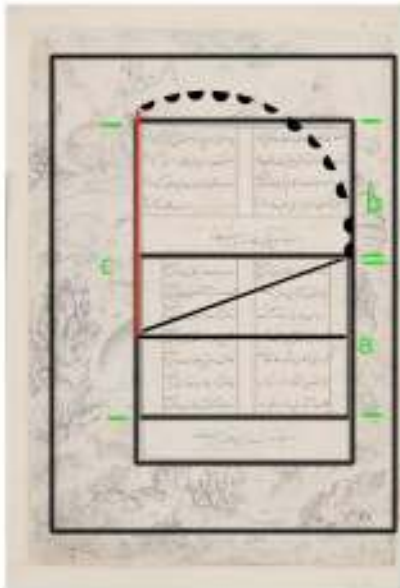


Fig. 2 Analysis of Fig. 1 of page space by golden proportions

The "golden ratio" is a criterion for determining some proportions in terms of shape and beauty, a method invented by the ancient Greeks and the mathematical formula has a lot of visual beauty [6]. Its mathematical formula is equal to $a \div b = c \div a$. As a result, if we divide a square by a perpendicular line, we get two equal rectangles. If the diameter of this rectangle is drawn from the intersection of the dividing line and we multiply this diameter by the radius of a hypothetical circle and draw a circle, the intersection of the compass is obtained along the side of the square c , the point where the "golden rectangle" can be drawn. Fig. 2 shows the space of the frames in the page composition. The text box inside the image box is divided into several separate boxes. The larger box is divided into two rectangles. The diameter of this rectangle is drawn along the side in the form of a radius of a circle, although they are not

exactly equal, but with a slight difference, a golden rectangle is created on top of it. Although the painter does not know the exact formula and proportions of gold, with his aesthetic sense, he was able still to create an almost golden rectangle, and form a well-proportioned composition on the page. According to Barthes' theory, a descriptiveness relationship is created between text and image. The image is supporting text.

D. Garshasb Nameh

Garshasb Nameh was illustrated in Shiraz in 800 AH during the Jalayrid period and is now kept in the British National Library in London. Garshasbnameh is one of the most valuable Persian writings and after Ferdowsi's Shahnameh is the highest epic memoir in Iran. The poet of Garshasbnameh, Hakim Asadi Tusi, is a poet of the 5th century AH. Garshasb is the world of an Iranian hero who has become very famous in Avesta" [13]. Simple backgrounds without much decoration, golden sky, various rocks and twists, high horizons, three-faced figures of this version.

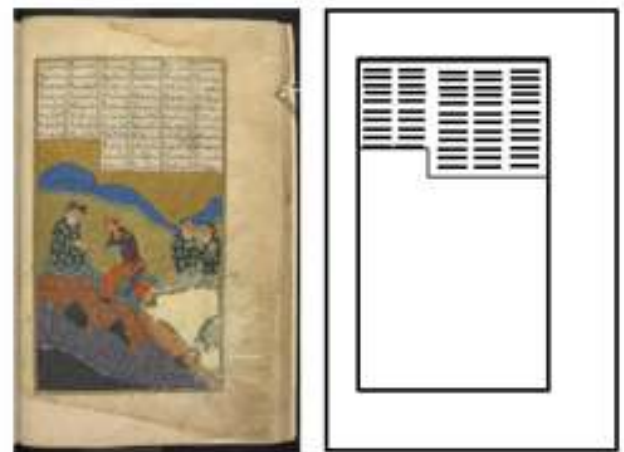


Fig. 3 Garshasbnameh, 9th century AH, British Museum

The Fig. 3 version of the Garshasbnameh, on this page, the text box is created at a distance from the edge of the paper and the image and text are placed inside this box. The box is not broken and the text box is not separated from the image [6], only the broken part of the text is separated from the image. The image occupies two-thirds of the page and the text is at the top of the page. The text of the text is written in six vertical columns and is shorter around the last column according to the form of the image in which a rock is raised at the top. The image and text frame has been painted golden according to the painter's choice, creating a state of the frame that is also commensurate with the golden color of the sky. The main space of this frame is covered by an image that narrates the text [10]. The visual connection between the text and the image is created with the main importance of the image. The text appears to enter the image and supports the image. The audience first reads the image, then draws attention to the text and reads the text [15]. As a result, according to Barthes' theory, a reference relationship is created between text and image. The image is a reference and the text supports it, although given the considerable space devoted to the text, it can be said that this reference relationship is tangible. The text is remarkable by

allocating 11 lines in six columns. In the image below, the proportion of text space is more specific.

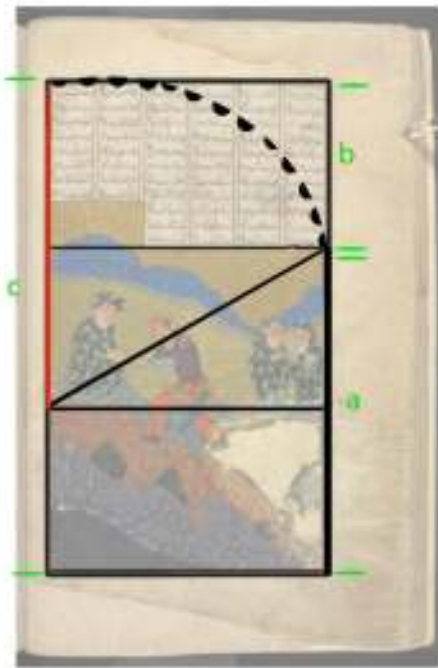


Fig. 4 Analysis of Fig. 3 of page space by golden proportions

Fig. 4 shows that the text box is about half the size of the image box. As a result, there is still considerable text on the page, and although the image is a reference, the role of the text is more noticeable. In the image above, if the frame of the image in which the narration is flowing is considered a square and divided into two parts, two rectangles of the same size are obtained, which if we draw the diameter of one of these rectangles and the radius of a hypothetical circle in Consider continuing alongside c and drawing the position of the hypothetical circle with side c as a rectangle. A golden rectangle is obtained and it can be seen that the text box is written exactly in this golden rectangle, which is equal to half a square of the image box. The result on this page is a well-proportioned and precise balance between text space and image space. The painter probably created this exact fit even without mathematical knowledge. Although the image has more space, the text also takes up less but significant space of the page, which is equal to the golden rectangle created. According to Barthes' theory, a reference relationship is created between text and image.

E. Version of Khajovi Kermani's Divan

The book of Khajovi Kermani's Divan was illustrated in 799 AH by Junaid Sultani in Shiraz. This is now housed in the British Library in London. "The main part of this book is dedicated to the romantic Masnavi of Hoday and Hodayoun, which was composed by Khajovi Kermani in 732 AH. This copy is in the calligraphy of Nastaliq Mir Ali Tabrizi and contains nine images." "Small paintings, landscapes of flowers and trees, richly decorated architecture, a wide variety of colors and rich colors and richly decorated backgrounds that are not

empty of patterns and colors are the features of this version of the paintings [17]. "The color of the meetings of this version is pure and brilliant and its compositions are beautiful and pleasant" [18].

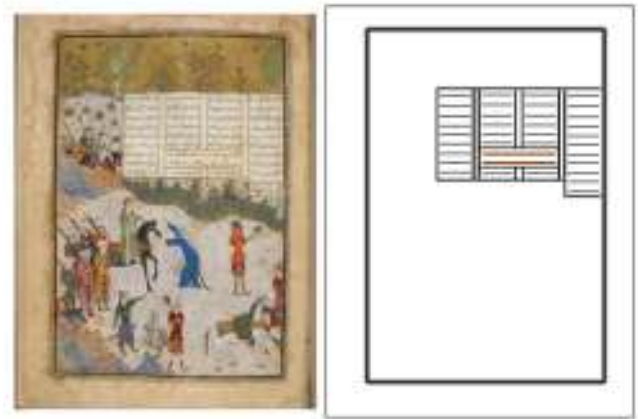


Fig. 5 Divan of Khajovi Kermani. 8th century AH, British Museum

In Fig. 5, a vertical frame with a distance from the edge of the special paper drawn on the drawing is a clear frame for the painter to place his image in [20]. The painter also uses all the large space of his frame, which is almost equal to the whole page, and places his visual elements in it. Full of patterns and decorations and small and large elements of statues, the nature of trees and flowers in such a way that it is difficult to find empty space (golden sky) on the page without a pattern. He did not leave the sky completely simple, decorated it with gold [9], and placed trees and birds in its heart. His visual elements formed a delicate grace with more prolific details in the form of soft curves. In this image, a space with a special box is dedicated to the text [19]. The frame is not completely rectangular but a hexagon at the bottom right with two extra bits causing the frame to stretch at the bottom. The whole text box is divided into four columns in which the text is placed [14]. The column against the right, which is attached to the image frame, is two bits longer than the other rows. In the middle of the drawn box, a rectangle is placed in the heart of it and it breaks the two middle columns that create the title box and is distinguished by two dark red bits. The text box is inside the image box and the image is surrounded by text. The main focus on this page is with the image and the image dominates the text [24]. The connection between the text and the image is still maintained and the frame also separates the specific space of the two. According to Barthes' theory, it can be concluded that the relationship between the text and the image is a reference communication. First, the image catches the audience's attention, the audience reads the image, then reads the text, the text supports the text and explains the image, the text is used to help better understand the image and easily convey the meaning of the narrative. The result is the image on this reference page.

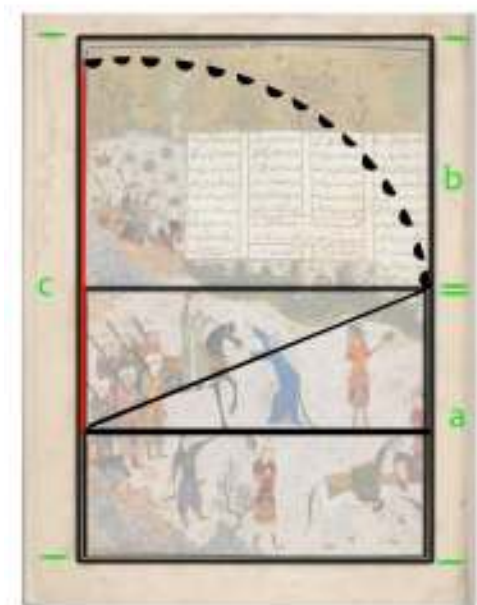


Fig. 6 Analysis of Fig. 5 of page space by golden proportions

How the space and composition of this page is created is shown in Fig. 6. The space at the bottom of the page is where the main subject of the narrative takes place and is selected as the main space of the image, which is located exactly below the text box. As a result, a rectangle is obtained. If we divide it into two parts and draw the diameter of the rectangle in the form of an imaginary circle chord and continue along the side, it will not reach the end of the image frame. However, with a slight difference, a golden rectangle is obtained. The painter has almost created a golden proportion and created a balance in his work page where the text box is placed inside this golden rectangle. However, it is not on the page, but is surrounded by images around the text box. The text box and the image box are in the right balance on the page. According to Barthes' theory, a descriptiveness relationship is created between text and image. The image is supporting the text.

TABLE I
Match text and image communication

Golden fit	Failure in the box	Image box	Text box	Figure
—	—	×	×	1
—	—	×	×	2

×	—	×	×	3
—	—	×	×	4
—	—	×	×	5
—	—	×	×	6

According to Table 1, it can be seen that in this period, there is a text and image box together, which shows the deep connection between painting and literature. We also see that in the Jalayrid period, the page is more important with the image and the image has more space. This creates a golden ratio between the text box and the image. In general, it can be seen that in this period, the drawing covers the main space of the page and the text enters it in one or more bits. The frames remain intact and no breaks are seen in the text and image frames. Golden proportions are not seen in the composition of the text and image frames. However, sometimes, based on the painter's sense, this golden proportion is almost created, which creates a balanced and symmetrical page, and sometimes it highlights this imbalance. In the more Jalayrid period, these proportions and compositions are closer to the golden and golden rectangle proportions. However, it is clear that the painter did not have accurate knowledge and mathematical knowledge of the golden ratio and only uses his aesthetic sense in composition. In Khajovi Kermani's divan, the balance in the way of highlighting the image is completely upset and the painter does not oblige himself to observe the balanced proportions and creates a special effect. According to Barthes' theory, descriptiveness and reference relationship are created between the text and image. The image is supporting the text and sometimes the text supporting the image.

V. CONCLUSION

According to studies, it can be said that in the Jalayrid period, the relationship between text and image, although more or less, has been preserved. In some of these examples, we see the importance of similarity on the page. According to the analysis performed, we observed that although the relationship between text and image has always existed, most of the data pages of this study in the Jalayrid period have a reference relationship, the text supports the image and narrates the image, the text to support the image Exists and supports it. Also, in the illustrated versions of the Jalayrid period, the text and the image, while they were close and connected, were always kept separate by the frame and placed in a suitable composition; this proportion is not in terms of mere balance and symmetry, but in terms of sense. Painter sometimes leads to asymmetry. Although the painter of this period is unaware of the mathematical and scientific proportions of the golden ratio, he creates a suitable combination with his theme based on his sense and never

completely separates the text from his painting and maintains this connection.

REFERENCES

- [1] Azhand, Yaghoub 2003 Baghdad Al Jalir School of Painting, Fine Arts Quarterly, No. 14.
- [2] Azhand, Yaghoub, 2005, Tabriz School of Painting, Qazvin, Mashhad “, Tehran, Academy of Arts.
- [3] Azhand, Yaghoub. 1389, Iranian Painting. Tehran, Samt Publications.
- [4] Barthes. R, 1977, Introduction to Structural Analysis of Narrative: Image Music Text” London:Fontana.
- [5] Connell, Ernst. 2008, Islamic Art. Translated by Houshang Taheri. Tehran, Toos Publishing.
- [6] Donis E. Dandis. 1397 Principles of Visual Literacy, translated by Masoud Sepehr. Tehran. Soroush Publishing.
- [7] Grabar, Ulk. 1390, A Review of Iranian Painting, Translated by Mehrdad Vahdati Daneshmand. Tehran, Academy of Arts Publications.
- [8] Gray, Basil. 1369, Iranian painting. Translated by Arab Ali Shrouh. Tehran, New Age Publishing.
- [9] Hosseini, Mehdi, 2007, illustrated version of the Divan of Sultan Ahmad Jalayer and Haft Wadi Mantiq al-Tair, Golestan Honar No.
- [10] Izadi, Alireza, 1397 Analysis of the relationship between text and image in the drawings of Khajovi Kermani Divan of Jalayeri School. Supervisor: Dr. Khashayar Ghazizadeh. To obtain a master's degree
- [11] Jelodar Hossein, 138, Continuity of text and image; Book of the Month of Art, No. 87 and 88.
- [12] Kenbay, Sheila 2002, Iranian Painting, Translated by Mahnaz Shayestehfar, Tehran, Institute of Islamic Art Studies
- [13] Khazaei, Mohammad, 2000, Designs of the Divan of Sultan Ahmad Jalayer, Tehran, Soura Institute.
- [14] Lane, George 1389, Iran in the Early Ilkhanid Period of the Iranian Renaissance. Translated by Seyed Abolfazl Razi .Tehran .Amir Kabir Publications.
- [15] Mir Hosseini, Javad 1390, The place of text in Iranian painting and its adaptation to page layout graphics, Payam Baharestan, No. 11.12.21
- [16] Namely, emotion. 1392. A study of the relationship between text and image in the great patriarchal Shahnameh of Demot, Master's thesis. Islamic Azad university.
- [17] Pakbaz, Rouin, 1987, The synchronicity of painting with literature in Iran, Tehran, Negah Publishing.
- [18] Pakbaz, Rouin. 2000, Iranian art from ancient times to today. Tehran: Zarrin and Simin Publications, sixth edition, 2007
- [19] Pope, Arthur Opham. 2010, The course of Iranian painting. Translated by Yaghoub Azhand. Tehran, Molly Publications.
- [20] Prizadian Kavan, Marjan, 2015, A Study of the Relationship between Frame (Frame) and Narrative in Painting of the Ilkhanid Era to the End of the Timurid Era “Supervisor: Dr. Asghar Fahimi for a Master's Degree.
- [21] Robinson, B.O. 1997. The Art of Iranian Painting. Translated by Yaghoub Azhand. Tehran, Molly Publications.
- [22] Sharifzadeh, Abdolmajid, 1996, History of Iranian Painting, Tehran, Islamic Propaganda Organization Art Center.
- [23] Shayestehfar, Mahnaz) 2008 (Review of manuscript drawings of Khajovi Kermani's divan in Shiraz school.
- [24] Yaghmaei, Habib, 1975, Garshasnameh, Tehran, Tahoori Library Publications.

Degemination in Emirati Pidgin Arabic: A Sociolinguistic Perspective

Abdel Rahman Mitib Altakhaineh, Abdul Salam Mohamad Alnamer, Sulafah Abdul Salam Alnamer

Abstract— This study examines the production of gemination in Emirati Pidgin Arabic (EPA) spoken by blue-collar workers in the United Arab Emirates (UAE). A simple naming test was designed to test the production of geminates and a follow-up discussion was conducted with some of the participants to obtain the complementary qualitative analysis. The goal of the test was to determine whether the EPA speakers would produce a geminated or degeminated phoneme. A semi-structured interview was conducted with a subset of the study cohort to obtain participants' own explanation where they degeminated the consonants. Our findings suggest that the exercising of this choice functions as a sociolinguistic strategy in a similar manner to that observed by Labov in his study of Martha's Vineyard. The findings also show that speakers of EPA are inclined to degeminate consonantal geminates to establish themselves as members of a particular social group. Reasons for wanting to achieve this aim were given as: to claim privileges only available to members of this group (such as employment) and to distinguish themselves from the dominant cultural group. The study concludes that degemination in EPA has developed into a sociolinguistic solidarity marker.

Keywords— sociolinguistics, morphophonology, degemination, solidarity, Emirati pidgin Arabic.

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Temperature Shocks and Rural Labour Markets: Evidence from India

Bhaskar Neog

Abstract— The present study contributes to the literature on labour reallocation and adaptation in response to weather anomalies. Existing literature on labour mobility and weather shocks primarily focus on migration to the neglect of worker commuting as a potential adaptation strategy. Utilising individual-level panel data from the Village Dynamics in South Asia (VDSA) dataset for the year 2010-2014, the present study explores the impact of weather anomalies on migration, commuting and the non-agricultural sector. The fixed-effects regression results show that negative temperature shocks induce a flow of labour outside the village through labour out-migration and longer-distance commutes. Temperature stress also negatively impacts non-agricultural earnings. The effects of temperature shocks are heterogeneous across the baseline climate of the villages suggesting evidence of adaptation to weather shocks. The study emphasizes the crucial role of labour mobility and adaptation in coping with weather shocks. The paper concludes with some policy suggestions.

Keywords— climate change, weather, migration, commuting.

The Impact of Small and Medium Scale Enterprise (SMEs) on Poverty and Unemployment Reduction in Kano State, Nigeria

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Abstract.

Small and Medium Scale Enterprise (SME) has proved to be a major tool adopted by the developed nations to attain socio- economic development. In recent time, small scale industrial sector is considered to be the backbone of modern-day economy. Historical facts show that prior to the late 19th century, cottage industries, mostly small and medium scale businesses controlled the economy of Europe. The Industrial Revolution changed the status quo and introduced mass production. This study examined the impact of Small and Medium Scale Enterprises (SMEs) on poverty and unemployment reduction of Kano State between 2006 and 2018. The study employs the use of secondary data which was sourced from CBN bulletin. This study adopted ex-post facto research design. Primary data from questionnaire distributed to sample population. 200 respondents from ten selected Local Government areas in Kano State were used for the study. Regression analysis was used with the aids of Statistical Package for the Social Sciences (SPSS) version 23 software. The results indicated that there is a positive and significant relationship between Small and Medium Scale Enterprise with poverty reduction, employment generation and in Kano State. The study recommended that government should encourage the youth to cultivate and nurture entrepreneurial spirit as a way of achieving gainful employment. The government should review and expand its skill acquisition program by creating additional skill acquisition centers in addition to the already existing ones in order to boost skill acquisition and entrepreneurial capabilities of the youths among other recommendations were made.

Keywords: Poverty, Unemployment, SMEs, Economic growth.

Introduction

The pursuit of economic development has been a major goal of many developing nations of the world. Developing countries are confronted with several problems such as high rate of poverty and unemployment which have continued to hinder the attainment of socio-economic development.

For any nation to attain development, industrialization, gainful and meaningful employment are important indices used as a measurement of economic development. This is often depicted by income per capital, equitable distribution of income, the welfare and quality of life enjoyed by the citizen of that nation. Small and Medium Scale Enterprise (SME) has proved to be a major tool adopted by the developed nations to attain socio- economic development. In recent time, small scale industrial sector is considered to be the backbone of modern day economy. Historical facts show that prior to the late 19th century, cottage industries, mostly small and medium scale businesses controlled the economy of Europe. The Industrial Revolution changed the status quo and introduced mass production (Thomas, 2001). The twin oil shocks during the 1970s undermined the mass production model, which triggered the unexpected reappraisal of the role and importance of small and medium sized enterprises in the global economy (Wendrell, 2003). In Nigeria, the introduction of SME can be traced back to the year 1945 when the essential paper No. 24 of 1945 on “A Ten year plan of development and welfare of Nigeria 1946 was presented”. Small and Medium scale Enterprise was considered an all time necessity at the beginning; which has gained prominence today and is expected to increase its importance in the future (Basil, 2005).

Small and Medium Scale Enterprises (SMEs) are recognized globally as the engine for growth of modern economies and it provide employment to a large portion of the population or citizens in a given economy than large enterprises and hence contribute to reducing poverty in the country. The realization of the roles play by SMEs in overcoming unemployment rate and hence poverty reduction has been an age of long phenomenon in Nigeria, but the right and actual policies and incentives coupled with the business environment have continued to hinder the pivotal or significant roles SMEs play in addressing Nigeria,,s economic problems (Oba & Onuoha, 2013). Oba and Onuoha (2013) state that issues relating to the development of SMEs have become essential for the growth and development of the most third world nations. It has been clear that they are no nation that ever develops without appreciable inputs from the SMEs segment of their economy. The performance of SMEs as instruments for economic growth and development and poverty reduction among the populace is the topic of interest. SMEs in the case of Nigeria have performed below expectation at a destitute result (Ihua, 2009). SMEs poor performance has added to the high rate of unemployment, poverty, and the low standard of living in the country. Though SMEs provide seventy percent (70%) industrial employment and sixty percent (60%) of agricultural sector employment, and it only account for ten (10%) – fifteen percent (15%) of the total industrial output with a capacity utilization of over thirty percent (30%). Inadequate funds have further aggravated the start-off operations of many business endeavours (Oba & Onuoha, 2013).

Many International Development Agencies, organisations, and financiers not only appreciate the great roles played by SMEs in poverty alleviation and overall economic development, but also invest a significant percentage of their resources in them (SMEs). A review of World Bank Operations revealed that it invested a whopping \$1.597 billion in SMEs in 2004 fiscal year, with Africa getting a sizeable share of over \$89 million. This sum was channeled through the four major

development arms of the bank: the International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA), the International Bank for Reconstruction and Development (IBRD), and the International Development Association (IDA). Nigeria, Kenya and Uganda benefited from part of the new joint pilot programme executed by IFC and IDA for SME development in 2004 to the tune of \$70million. The 2004 annual review of the IFC's Small Business Activities indicate that the IFC and IDA began SME project development in Nigeria worth \$32 million. In Kenya and Uganda, \$22 million and \$16 million were also respectively invested in similar projects.

One major drawback in Nigeria's quest for industrial development over the past years has been the absence of a strong, vibrant and virile SME sub-sector. Given a population of well over 120million people, vast productive and arable land, rich variety of mineral deposits, as well as enormous human and other natural resources, Nigeria should have been a haven for Small and Medium Enterprises with maximum returns as it also has the location advantage as a marketing hub for the West and even East African Countries.

Kano State is a state located in North-Western Nigeria. Created on May 27, 1967 from part of the Northern Region, Kano state borders Katsina State to the north-west, Jigawa State to the north-east, and Bauchi and Kaduna states to the south. The capital of Kano State is Kano.

Kano State is the second largest industrial center in Nigeria and the largest in Northern Nigeria with textile, tanning, footwear, cosmetics, plastics, enamelware, pharmaceuticals, ceramics, furniture and other industries. Others include agricultural implements, soft drinks, food and beverages, dairy products, vegetable oil, animal feeds etc. The state has put in place policies and established Enterprise and Economic Development Agencies to encourage promote and coordinate investment activities in the State with a view to stimulating economic growth. One of such developmental strategies is the industrial development and expansion of Small and Medium Scale Enterprises (SMEs). Past and the present governments of Kano State have emphasized the contributions of internal developed economy of the State through the encouragement of SMEs. In this present administration in Kano state, several meetings have been held with the Nigeria Association of Small and Medium Enterprises (NASMEs), Kano chapter in order to promote the micro, small and medium enterprises in the state.

Nevertheless, despite the efforts and contributions of past and present government towards promoting SMEs in Kano State, the contribution of this sector to the economy still remain relatively small in terms of its impact on Gross Domestic Product (GDP), unemployment and poverty reduction. The rate of unemployment in this state is still high and majority of the population still live in poverty. Ekezie (1995), Bacdom (2004), Iromaka (2006), Aremu, (2010) among others attributed the lack of credit as one the major constraint to the realization of the benefits of SME. In the light of the above, this study attempt to examine the impact of SMEs on poverty and unemployment Reduction of Kano State, the researcher embarked on the analysis of SME in Kano state, between the year 2006 and 2018.

In a related study of SMEs, job creation and poverty reduction in Nigeria, Aremu & Adeyemi (2011) revealed that the multiplier effect of SMEs enable it to act as a catalyst for economic growth. The study affirmed that SMEs led to employment generation and creation of wealth which invariably resulted to equitable income distribution and poverty reduction. Furthermore, the study concluded that poor policy monitoring and coordination were the cause of failure of previous intervention programmes of government towards enhancing SMEs in Nigeria.

Oba & Onuoha (2013) analyze the employment generation capacity of SMEs in reducing poverty in Nigeria using simple OLS techniques on a secondary data. The result showed that SMEs through its job creation capacity reduces the level of poverty in the country. It further posited that availability of funds and government interventionist policies are not responsible to the growth of SMEs in Nigeria.

However, Edom, Inah & Emori (2015) employed OLS method to analyze the effect of SMEs lending in reducing poverty in Nigeria between the periods of 1991 and 2010. The results showed that finance to SMEs reduces poverty rate in Nigeria while the level of unemployment has a negative consequence on poverty level in the country.

The main objective of this study is to examine the impact of Small and Medium Scale Enterprises (SMEs) on poverty and unemployment reduction of Kano State between 2006 and 2018 and the specific objectives are to:

1. investigate the impact of SMEs on poverty reduction in Kano State;
2. examine the impact of SMEs on employment generation in Kano State and
3. examine the impact of SMEs in improving the standard of living in Kano State.

Research Hypotheses

- H₀– Small and Medium Scale Enterprise is not significantly related to poverty reduction in Kano State. •

H₀ – Small and Medium Scale Enterprises have no significant impact on employment generation in Kano State.

Methodology

This study adopted a survey research design to investigate the impact of Small and Medium Scale Enterprises (SMEs) on poverty and unemployment reduction of Kano State. Survey research method shall be used to gather information from respondent concerning their opinions on financial intermediation among the Micro Small and Medium Scale Entrepreneurs in Nigeria with reference to ten local government areas in Kano state. Therefore primary and secondary source of data were

used. The researcher designed an interview schedule as one of the data collection instrument for this study. The interview questions were aimed at eliciting relevant information concerning the Micro Small and Medium Scale Entrepreneurs in Nigeria. Question relating to methodology and material for Micro Small and Medium Scale Entrepreneurs, perceived problems of it were asked during the interview schedule. To analyse the data generated from the questionnaire surveyed, Regression and correlation analysis were used to determine the relationship between SMEs and Poverty reduction and SMEs and employment generation in Kano State with the aid of SPSS version23.

POPULATION OF THE STUDY

The target population for this research covers all the Small and Medium Scale Entrepreneurs in ten (10) local government areas of Kano state.

3.4 SAMPLING SIZE

A simple random sampling procedure was used for selecting the participants in this study. This technique was used to ensure fair equal representation of the variable for the study. The stratification was based on some selected Micro Small and Medium Scale Entrepreneurs in ten (10) local government area of Kano state. Within each section, selection of staff was by simple random sampling. This was achieved by writing out the names of the staffs on a piece of paper which was folded and put in a basket. After thorough reshuffling, the researcher selects an element, record it and put it back in the basket until the required number is obtained. That is, researcher applied sampling with replacement.

THEORETICAL FRAMEWORK

This research is based on the active learning model of Erickson and Pakes(1995) which states that a firm explores its economic environment actively and invests to enhance its growth under competitive pressure from both within and outside the firm. The potential and actual growth changes over time in response to the outcomes of the firm's own investment and those of other actors in the same market. According to this model of learning, owners or managers of SMEs could raise their efficiency through formal education and training that increases their endowments while government may support their activities through the creation of the enabling environment. Entrepreneurs or managers of SMEs with higher formal education, work experience, training and government assistance would therefore be expected to grow faster than those without these qualities. This implies that SMEs in Nigeria have prospects of experiencing growth and contributing meaningfully to employment generation only when appropriate investments are made into them by all the stakeholders. This could best be achieved by government intervention through

the provision of financial assistance, social infrastructures, capacity building of SME operators and favourable taxation policies (Ericson & Pakes, 1995).

3.3 MODEL SPECIFICATION

This model specified below adapt from the work of Gwaison, Maimako and Maimako(2018) as follows;

Conceptual Model

$$POVR = f(SMEs).....1$$

$$EMPG = f(SMEs).....2$$

Where:

POVR= Poverty Reduction

EMPG= Employment Generation

SMEs= Small and Medium Enterprises

Analytical Model

$$POVR = \alpha + \beta SMEs + \mu_i.....3$$

$$EMPG = \alpha + \beta SMEs + \mu_i.....4$$

Where:

α = intercept

β =Coefficient of the explanatory variables(Slope)

μ_i =Error term.

Results presentations and Discussion of Findings

200 (Two Hundred and Eighty Seven) respondents were used for the study. This involved selected entrepreneurs business from big business to that of ordinary business who could read and write. The questionnaires distributed are summarized in Table 1 below:

TABLE 1: Analysis of Responses from the Questionnaire

Questionnaire	No. of Respondents	Percentage (%)
Questionnaire distributed	200	100
Questionnaire retrieved	191	95.5
Un-retrieved Questionnaire	9	4.5
Questionnaire used in analysis	180	90
Unable questionnaires	11	5.5

Source: Field Survey, 2019.

In all, 200 questionnaires were administered on the employers of SMEs in 44 LGA of Kano State. From the total questionnaires distributed, 191 (95.5%) were retrieved while 9 (4.5%) were not retrieved because every effort to collect them from the respondents failed. 11 (5.5%) of the retrieved questionnaires were unable because they were not scored properly by the respondents. Therefore, 180 (90%) of the total questionnaire were used in the analysis of this study.

Table 2: Descriptive statistics for Demographic data

Statement of Items		Frequency	Percentage (%)
Gender	Female	121	67.2
	Male	59	32.8
	Total	180	100.0
Age Range	Below 25 years	50	27.8
	25-35 years	42	23.3
	36-45years	57	31.7
	46years and above	31	17.2
	Total	180	100.0
Marital Status	Single	48	26.7
	Married	81	45.0
	Divorced	27	15.0
	Widow/Widower	24	13.3
	Total	180	100.0
Educational Qualification	SSCE	41	22.8
	ND/NCE	62	34.4
	HND/B.Sc	38	21.1
	MBA/M.Sc/Ph.D	21	11.7
	Others	18	10.0
	Total	180	100.0
Length of Service Experience	Less than 5 years	15	8.3
	5-10years	32	17.8
	11-15years	68	37.8
	16-20years	37	20.6
	21years and above	28	15.6

Total	180	100.0
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SOURCE: Authors' Computation SPSSV25

From table 2 above, out of 180 (100%) respondents, 59(45%) were females while 121 (55%) were males. This shows that among the owners of SMEs in 44 LGA of Kano State, males were more in number among the respondents. The distribution of respondents' age indicates that 27.8% of them were below 25 years ; 23.3 % fall in the age range of between 25 and 35 years; 31.7% were between 36 and 45 years and 17.2% for ages 46 and above. This implies that the majority of the respondents are between the ages of 36-45 years. The marital status of the respondents'. 26.7% of the respondents were single, 45.0% were married, 15.0 % were divorced and 13.3% were widow and widower. This implies that majority of the respondents were married and had various SMEs to sustained their families. Level of educational attainment is important in determining the quality of responses in any survey. Table2 illustrates the highest educational qualification attained by the respondents. According to this table, 22.8% of the respondents had Secondary Certificate (SSCE) or its equivalent; 34.4% had National Diploma/ NCE; 21.1% had HND/B.Sc; 11.7% had MBA/M.Sc/Ph.D and 10% had other qualifications not specify above like trade test certificates, professional qualifications and adult education / Quranic education . An employee's length of service experience in SMEs might have impact on his/her attitude towards a particular job. Therefore, table 2 shows the various lengths of service of the selected respondents in SMEs. Of the 180 respondents used in this study, only 8.3% of them served for less than five year in the SMEs.. 17.8% have served between 5 and 10 years; 37.8% have served between 11 and 15 years; 20.6% for 16– 20 years and 13.6% for 21 years and above respectively. This implies that the majority of the respondents had been in SAMEs for II-15 years which is adequate enough to understand SMEs

STATISTICAL TEST OF HYPOTHESES

The two hypotheses earlier formulated under the introduction section of this study were approached by the use of regression and correlational statistical tool. The SPSS version 23 will be used for the analysis.

$H_0: \beta_0 = 0$ (Null hypothesis)

$H_1: \beta_1 \neq 0$ (Alternative hypothesis)

The decision rule is that a null hypothesis will be accepted when p-value is greater than 0.05 and vice versa.

Hypothesis 1: Small and Medium Scale Enterprise is not significantly related to poverty reduction in Kano State.

Table 1: Showing Regression, Correlation analysis between Small and Medium Scale Enterprise and poverty reduction in Kano State.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-.331	.046		-7.193	.000
poverty reductions	.371	.016	.865	23.026	.000

a. Dependent Variable: SMEs

Regression Model

$$POVR = -0.331 + 0.371SMEs + \mu_i \dots \dots \dots 5$$

The regression model explains that small and medium enterprises (SMEs) has a positive relationship with poverty reduction (POVR). An increase in One unit of SMEs would lead to a proportionate increase of 0.371 unit in poverty reduction in Kano State and vice versa. The correlation coefficient of 86.5 percent indicates a strong positive relationship between small and medium enterprises (SMEs) and poverty reduction. The P value was 0.000 which was less 0.05 means that the P value is statistically significant at 5% level. Since tcal (23.026) is outside our acceptance region (+/- 1.96), we therefore reject the null hypothesis and uphold the alternative hypothesis. That is, there is a significant relationship between Small and Medium Scale Enterprise and poverty reduction in Kano State.

Hypothesis 2: Small and Medium Scale Enterprises have no significant impact on employment generation in Kano State.

Table 2: Showing Regression, Correlation analysis between Small and Medium Scale Enterprises and employment generation in Kano State.

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	-.288	.051		-5.693	.000
employment generation	.345	.017	.833	20.054	.000

a. Dependent Variable: SMEs

Regression Model

$$EMPG = -0.288 + 0.345SMEs + \mu_i \dots\dots\dots 6$$

The regression model in equation 6 explains that small and medium enterprises (SMEs) has a positive relationship with employment generation (EMPG). An increase in One unit of SMEs would lead to a proportionate increase of 0.345 unit in employment generation in Kano State and vice versa. The correlation coefficient of 83.3 percent indicates a strong positive relationship between small and medium enterprises (SMEs) and employment generation. The P value was 0.000 which was less 0.05 means that the P value is statistically significant at 5% level. Since tcal (20.054) is outside our acceptance region (+/- 1.96), we therefore reject the null hypothesis and uphold the alternative hypothesis. That is, there is a significant relationship between Small and Medium Scale Enterprise and employment generation in Kano State.

Discussion of Findings

This study shows that there is a significant relationship between Small and Medium Scale Enterprise and poverty reduction in Kano State. And also that is, there is a significant relationship between Small and Medium Scale Enterprise and employment generation in Kano State. This findings agreed with the works of Aremu & Adeyemi (2011) which revealed that the multiplier effect of SMEs enable it to act as a catalyst for economic growth. The study affirmed that SMEs led to employment generation and creation of wealth which invariably resulted to equitable income distribution and poverty reduction. Edom, Inah & Emori (2015) who found that finance to SMEs reduces poverty rate in Nigeria while the level of unemployment has a negative consequence on poverty level in the country. Lastly Oba & Onuoha (2013) revealed that SMEs through its job creation capacity reduces the level of poverty in the country. It further posited that availability of funds and government interventionist policies are not responsible to the growth of SMEs in Nigeria.

Conclusion and recommendations

Following the finding stated above, the researcher therefore concluded that for a nation irrespective of its economic ideology to achieve meaningful and sustainable development, adequate attention must be given to wide spread of economic activities through small and medium scale enterprise. The youth as a major contributor to all round economic growth and development must be given due attention and their yearning for job security must be primary and paramount since they possess greater capability to move the economy forward and reduce the prevalent rate of poverty in Kano State, Nigeria . This will be easily achieved by encouraging them to be entrepreneurial and focus.

Based on the findings and conclusions stated above, the researcher therefore recommended the following:

The present and future governance to achieve impressive development, more job should be created especially for the youths in the form of small and medium scale enterprises through policy formulation and implementation since SMEs and economic development are related.

The government should encourage the youth to cultivate and nurture entrepreneurial spirit as a way of achieving gainful employment.

The government should review and expand its skill acquisition programme by creating additional skill acquisition centers in addition to the already existing ones in order to boost skill acquisition and entrepreneurial capabilities of the youths.

Government should increase its efforts towards the provision of infrastructure such as electricity, and transport without which SMEs cannot thrive efficiently.

Government in Nigeria should establish more agencies to assist the existing ones such as the EFCC and ICPC to tackle bribery and corruption headlong, as businesses cannot thrive in an environment where bribery and corruption thrive.

In addition, proper monitoring and funding of such programme should be exercised in order to identify loopholes therein so as to enhance the achievement of its objectives.

Lastly, attaining the status of the economic development of the western world, Nigeria as an economy should make herself SME driven economy that is adequately supported by the needed fund. In addition, the government should encourage the creation of more micro finance banks that are well supported and regulated to render necessary financial supports.

REFERENCES

- Akwani, C. (2007). The Five Stages of Small Business Growth, *Harvard Business Review*, pp.30-50.
- Alasan, S.L. and Yakubu, A.L. (2011). An Empirical Study of Small Scale Financing in Nigeria. *Journal of Unilorin Business School*, 1 (1), pp. 87-96.

- Anyanwu, A. (2001). Small and Medium Enterprises (SMES) In Nigeria: Problems and Prospects, *Ph.D. Thesis, St. Clements University*, pp. 79-82.
- Aremu, M.A. (2010). Small and Medium Scale Enterprises as a Means of Employment Generation ND Capacity Building in Nigeria, *A paper Presented at the International Conference on Management and Enterprise Development on, "Intellectual and New Strategies for Sustainability Development of the Third World" Held at Conference Center, University of Ibadan, Ibadan, Nigeria, October 5 – 8*, pp. 39-48.
- Bacdon, C.T. (2004). Small Scale Industries and Economic Development in Ghana: Business and Strategies in informal sector Economics, *VerlagBreitenbech, Saarbruckh, Germany*, pp. 19-23.
- Basil, A.N.O. (2005) Small and Medium Enterprises (SMES) In Nigeria: Problems and Prospects, *Ph.D. Thesis, St. Clements University*, pp. 46-59.
- Ekezie, C. (1995). Breakdown of Business Ventures in Nigeria, in Gladwin, A. (2000) (ed.) *Entrepreneurship: a conceptual approach*. Lagos: Concept Publishers Limited, p. 69
- Essien, P. and Udofia, A. (2006). Evolving a National Framework for the Emergence of a Strong and Virile Small and Medium Scale Industry Sub-Sector in Nigeria. A Seminar Paper Presented at MAN House, November 5th, p3.
- Ericson, R., and A. Pakes, 1995, "Markov-Perfect Industry Dynamics: a Framework for Empirical Work", *Review of Economic Studies*, 62(1): 53-82.
- Government of Ekiti State (2014). Unemployment: Ekiti government set to boost SMEs. Retrieved from [http:// ekiti state.gov.ng](http://ekiti.state.gov.ng)
- Government of Ekiti State (2014). Internal Economic Policy: A reliable tool for Rapid Development. Retrieved from [http:// ekiti state.gov.ng](http://ekiti.state.gov.ng)
- Husmanns, R., Mehran, F. and Verma, V. (1990). Surveys of Economically Active Population, Employment, Unemployment and Underemployment: An ILO Manual on Concepts and Methods, ILO: Geneva.
- Husmanns, R. (1994). International Standards on the Measurement of Economic Activity, Employment, Unemployment and Underemployment, *Bulletin of Labour Statistics, ILO, Geneva*, 1994-4, pp.
- ILO (1983). Thirteenth International Conference of Labour Statisticians, Resolution Concerning Statistics of the Economically Active Population, Employment, Unemployment and Underemployment, *Bulletin of Labour Statistics, ILO, Geneva*, 1983-3, pp. xi-xv.
- ILO (1990). *Statistical Sources and Methods*. Vol. 3, Economically Active Population, Employment, Hours of Work (Household Surveys), Geneva.
- ILO (1998). "Unemployment", *Bulletin of Labour Statistics, ILO, Geneva*, 1998-3, pp. 52-54
- Ikherehon, I.G.(2002). *The Practice business guide for the entrepreneur in Africa*. Lagos: Pathead

- Enterprises, p. 88.
- Ireghan, C. (2009). *Small Scale Business Development in Nigeria.*, in Ireghan, C. (ed.) The Place of Small and Medium Scale Business in the development of a nation State. Nigeria: Lagos, Kaycee Publishers, pp. 79.
- Iromaka, C. (2006). *Entrepreneurship in small business firms*. Ikeja: G-Mag. Investments Ltd, (Educational Publishers), pp. 49-56.
- Izedomi, A. (2011). *Principles of Management, Nigeria*: Benin, Alfred-Joe Publishers, pp. 73-78
- Khan, P. (2000). Marketing and National Economic Development”, *Marketing Journal*, Vol. 5 No. 2, pp.2-5.
- Jhingan, M. L. (2007). *Macroeconomic theory*. 11th ed. New Delhi, Vrinda Publications (P) ltd.
- Keynes, J. M. (1936), *General Theory of Employment, Interest and Money*, Palgrave Macmillian, (2007 Ed.).
- Levitsky, Jacob (1996). “Support Systems for SMEs in Developing Countries: A Review”, Paper commissioned by the Small and Medium Industries Branch, United Nations Industrial Development Organization, March.
- Obi, P. (2001). Ensuring the Socio-Economic Growth of a Nation. *A Paper Presented at a Conference in Johannesburg, between 12th and 15th December*, p. 8.
- Ojukwu, D. & Georgiadou, E. (2007). Towards improving inter-organizational trust among SMEs: a case study from developing countries. *Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries, Sao Paulo, Brazil*.
- Okuneye, P. A., Fabusoro, E., Adebayo, K., & Ayinde, I. A. (2004). The Nigerian agriculture and poverty incidence: The need for private sector empowerment. *In Farm Management Association of Nigeria Conference. Abuja* (pp. 19-21).
- Olutunla, G. T., (2005). Implementation of the small and medium industries equity investment scheme in Nigeria. [Online] Available: <http://www.sbaer.uca.edu/research/icsb/2005/153.pdf>. (July 7, 2020).
- Omoruyi, O. & Okonofua, B. A. (2005). Cottage Industries: A Tool for Rural Development and Poverty Reduction in Nigeria. *Benin Journal of Social Sciences* 13(1) 13-26.
- Onourah, P. (2009). The role of Small and Medium Sized Enterprises for Economic Growth: A Case Study of Matori LGA in Lagos, Nigeria. *Master's Thesis, School of Management, Blekinge Institute of Technology*.
- Onugu, B. A. N. (2005). Small and medium enterprises (SMEs) in Nigeria: Problems and prospects. *St. Clements University*.

- Osamwonyi, I. O. & Tafamel, A. E. (2010). Options for Sustaining Small and Medium Scale Enterprises in Nigeria: Emphasis on Edo State. *African Research Review*, 4(3).
- Rahanaty, F. (2009). Issues in Business Development. *Social Science Journal*, Vol. 8, No. 2, pp.36-44.
- Sansui, J. O. (2003). Overview of Government's efforts in the development of SMEs and the emergence of Small and Medium Industries Equity Investment Scheme (SMIEIS). *Lagos on 10th of June*.
- Small and Medium Enterprises Agency of Nigeria (SMEDAN) (2005). SME Success Digest. 3(1), January-June, 2005.
- Storey, D. J. & Cressy, R. (1995). Small Business Risk: a Firm and Bank Perspective. Working Paper, SME Centre, Warwick Business School.
- Wendrell, S. (2003). *Themes and Perspectives to Development*. USA, Heinemann Publishers, pp. 87-94.

Challenge and Benefits of Adoption ISO 9001 Certification in Algerian Agribusiness

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Abstract:

This article presents the status of ISO 9001: 2000 certification in some agro-food companies in Algeria. The article discusses challenges and contributions of certification as perceived by quality managers as well as the difficulties encountered during certification. It also provides the recommendations of these managers for companies that have a certification project. The results show that the top three reasons for adopting ISO 9001: 2000 certification are building a better organization, reducing the costs of non-compliance and meeting customer expectations. The contributions are of an external nature (recognition, brand image, extension of markets, etc.) but also of an internal nature (improvement of the organization, etc.). The recommendations mainly concern management motivation, staff awareness and involvement and compliance with the requirements of the standard.

Key words : quality management, certification, ISO 9001: 2000, food companies

Introduction:

The implications of ISO 9001: 2000 certification for Algerian companies remain largely unknown. So what are the perceptions of the quality managers of certified organizations with regard to ISO 9001: 2000? What do they think of the influence of ISO 9001: 2000 certification on the quality management of companies? What are the reasons that prompted companies to obtain ISO 9001: 2000 certification ?

This research aims to answer these questions based on qualitative research carried out with 17 quality managers in certified companies. The main objective of this research is to understand how the ISO 9001: 2000 system is perceived by managers in certified organizations. After recalling the interest of certification to the ISO 9001 standard and the general orientations of work on this topic, we will describe the research method used. The main types of perceptions and behaviors in relation to ISO 9000 will then be explored.

2 Literature review (ISO 9001 certification: 2000)

2.1 ISO 9000: 2000 and ISO 9001: 2000:

To avoid any confusion, the ISO 9000: 2000 and ISO 9001: 2000 standard should be defined. First published in 1987, ISO standards have undergone two changes in 1994 and in 2000. ISO 9000 is a set of quality management standards published by the International Organization for Standardization (ISO »[1]. (ISO, 2008)).

The 2000 version of the ISO standards gives particular importance (Jaupi, 2002):

To the satisfaction of customers and interested parties (staff, suppliers, society);

To continuous improvement of performance;

The process approach;

Resource management;

The human resources component;

2.2 Why is a company seeking certification?

Many studies dealing with ISO 9000 certification have been carried out around the world. The reasons for certification may be internal to the company, others may be external. Most often both reasons are advanced.

Certification can serve as a tool for quality recognition. Boéri (2006), for his part, considers that certification is "a major act in the life of a company, which aims to assess and recognize the conformity of the Quality Management System of a company to ISO 9001 version 2000 [2] (standards defined by the International Standard Organization defining the Quality Management System) "[3].

In their article on the implementation of the ISO 9000 quality system in Greek companies, Lipovatz, Stenos and Vaka (1999) come to the conclusion that the most important reason for establishment of the quality assurance system in Greek companies refers to the external impact of certification (i.e. adaptation to the domestic and / or international market) and not to the internal impact of certification (i.e. improving the organizational structure and reducing production costs).

Beattie and Sohal (1999) who conducted their research with Australian companies on "the benefits of adopting ISO 9000 certification" conclude that i) the main benefit of ISO certification as perceived by customers, is to give confidence ii) companies see it as a strategy of market share or to defend their position in the market iii) governments see it as a means of

increasing the efficiency of the industry which, in the long term, will allow companies to gain markets abroad and improve the trade balance [4].

An analysis of the information obtained from the processing of 749 questionnaires completed by Spanish companies allowed Escanciano, Fernandez and Vazquez (2001) to assert that in the opinion of quality managers, Spanish companies recognize the importance of certification that they see as a management tool that produces competitive advantages and that these same managers see certification as a path of progress towards total quality management.

Based on data from empirical research results on 502 Spanish companies to determine the benefits of implementing this standard, Casadesus, Gimene and Heras (2001) found the existence of different types of companies. According to their study, almost 65% of certified companies in Spain have achieved significant internal and external benefits. According to this study, many companies have recognized that the reasons for certification are exclusively commercial increase in market share, retention of current customers, quality image.

For Terziovski, Power and Sohal (2003), the main motivation for pursuing ISO 9000 certification. For other authors, certification also presents other advantages than external ones. Thus, Hoyle (2006) argues that while ISO 9001 certification is not a customer requirement, it may have some advantages for some organizations such as i) the value of an independent audit of the company's management system, ii) pressure to formalize the management system or iii) the recognition that certification brings on the market [5] on turned out to come from customers.

2.3 The status of ISO 9001: 2000 certification in the world and in Algeria:

ISO Survey provides information on the number of certified companies worldwide and by country. There is also a change in the number of certified companies in 2019, which clearly indicates an increase. At the top 10 of the number of ISO 9001: 2000 certified companies, China leads the pack, followed by Germany and India (see table 1). The presence of Germany, France and Czech Republic in this ranking demonstrates the importance of ISO 9001: 2000 certification in the Mediterranean area. Being part of this zone, Algerian companies can only take note and react accordingly.

In terms of companies certified ISO 9001: 2000, in the region Mediterranean, Algeria is among the bottom of the class in terms of the number of certified companies (see table2). For agri-food companies in Algeria, certification is a recent phenomenon: from 2000 to 2019.

Table1: Top 10 countries for ISO 9001 : 2000 certificates in the world

Country	Certificates
China	280 386
Germany	47 868
India	34 397
Japan	33 330
France	21 696
Brazil	17 952
Korea (Republic of)	12 851
Czech Republic	12 439
Poland	11 460
Colombia	10 463

The iso survey of management system standard certifications – 2019 –

Table 2: Number of ISO 9001 certificates in some Mediterranean countries

Country	Certificates
Egypt	2271
Tunisia	1105
Morocco	1066
Algeria	499
Libya	28
Mauritania	9

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Methodology:

A questionnaire relating to the identification of the company, the quality process and the certification was sent to certified agri-food companies. With regard to certification, questions are asked about the reasons and motivations for the certification process, the challenges of certification, the contributions of certification, the perceived impact of ISO certification on the markets, the difficulties encountered, the strengths and weaknesses of certification, advice and improvements suggested to companies aiming to become certified. The questionnaire was completed by senior executives or those responsible for certification in companies. With the exception of three respondents, a company director, an executive assistant and an assistant CEO, all responsible for quality management, the people who completed the questionnaire officially hold the position of "quality management manager".

The survey involved twenty ISO 9001 version 2000 certified companies (18 agri-food companies, a transport subsidiary belonging to an agri-food group, a food packaging manufacturing company), 17 of which completed the questionnaire. Among the latter, 8 companies are public and 9 private. Regarding funding for the establishment of the certificate, 11 benefited from the Competitiveness Promotion Fund, 2 received funding from UNIDO and 4 used their own resources. It should be noted that the number of food companies, which filled

in the questionnaire, represents 89% of all food companies certified ISO 9001: 2000 on the national territory. If we take into account the total (all sectors combined), the 17 companies in our sample represent 17% of all companies that have the certificate.

4 RESULTS:

4.1 Reasons for certification:

Before discussing the determining factors that pushed companies to adopt ISO 9001: 2001 certification, we wanted to know whether the primary objective was to be certified or to implement a quality approach in the company. It seems that the objective of the implementation of ISO 9001: 2000 certification is (82%) the implementation of a quality approach within the company (see **table 3**). Regarding the reasons which prompted companies to obtain certification (see **table 4**), the answers give equally "improvement of the company's brand image" and "to stand out from the competition". Subsequently, they give in order the following propositions: "Improvement of management practices, more rigor, better documentation "; "to be able to access a new market "; "to formalize the existing management system in the company ". At the end of the pack comes "customer demand". Reasons such as access to the international market (possibility to export products), cost reduction, business sustainability, continuous improvement,... are also cited by respondents. For greater clarity, we asked respondents to tell us the three main reasons for the company's commitment to ISO 9000: 2000 certification (see **table 5**). The first three positions are respectively occupied by: "Establish a better organization" (82%); "Reduce non-compliance costs "(65%); "Meeting customer expectations "(65%). In fourth place comes "Being more competitive" (47%) followed by "Formalizing procedures" (18%).

Table 3: The objectives of ISO 9000: 2000 certification

	Get certified			Implement a quality approach within the company		
	Yes	No	Total	Yes	No	Total
Frequency	8	9	17	14	3	17
Percent	47	53	100	82	18	100

Table 4: The reasons that prompted companies to obtain certification for ISO 9000: 2000 standard

	Strongly agree	Agree	Disagree	Strongly disagree	Total
To be able to access a new market	65	23	6	6	100
To formalize the existing management system in the company	41	23.5	12	23.5	100
Because it was a customer requirement	6	12	29	53	100
To differentiate from the competition	82	18	0	0	100
To improve the image of the company	82	18	0	0	100
Improved management practices, more rigor, better documentation	76	14	0	0	100

Table 5: The three main reasons why companies have initiated a certification process

	PERCENT
Set up a better organization	82
Promote the company	12
Comply with the regulations	6
Reduce costs of non-compliance	65
Respond to the wishes of the business owner	6
Follow a group approach	0
Improve some services	0
Formalize procedures	18
Be more competitive	47
Meet customer expectations	65

4.2 The challenges of certification:

According to the answers given, the challenges of certification are internal and external (see **Table 6**).

The internal issues that have obtained the approval of the respondents are that the certification:

- Allows a better organization of the company (100%);
- Allows better organization of production (100%);
- Reduces non-quality costs (100%);
- Improves product quality (82%).

External issues:

- Provides an export advantage (100%);
- Provides an advantage in terms of brand image (94%);
- Provides a competitive advantage (94%);
- Provides assistance for the award of contracts following a call for tenders (76%).

Other questions were asked to support the answers concerning quality issues. The question was whether:

- Customers or other stakeholders have already requested ISO certification;
- Being ISO certified has helped you obtain certain contracts;
- The company is inclined to trust one ISO certified supplier more than another.

The survey shows that companies are more likely to trust one ISO certified supplier than another (100% positive responses).

The certification has enabled a few companies (five of them, or 29%) to obtain certain contracts. It was a customer requirement for only three companies (18%).

Table 6 : The challenges of certification

	Yes	No	Total
Help for awarding contracts following a call for tenders	76	24	100
Improves product quality	82	18	100
Provides an advantage in terms of brand image	94	6	100
Provides a competitive advantage	94	6	100
Allows better organization of the company	100	0	100
Allows better organization of production	100	0	100
Provides export advantages	100	0	100
Allows to reduce "non-quality" costs	100	0	100

4.3 The benefits of certification:

What are the benefits of ISO 9001: 2000 certification? To find out what certification does for the company, we asked the leaders of certified companies to do an assessment. The answers provided are presented in table 7 . Respondents “totally agree” on the fact that certification “is an external recognition of the efforts made”, “provides advantages for export”, “allows to reduce the costs of non-quality ”. Likewise, certification "improves the image of the company", makes it possible to stand out from the competition ". With a slight hesitation, the certification "helps mobilize staff" and "prevents the company from losing customers". When asked whether the contributions of the certificate are considerable, important, low or non-existent, it is confirmed that it is a significant contribution in 70%, low in two cases (is12%). **Table 8** highlights the positive contribution of certification.

Table 7: the benefits of certification

	Strongly agree	Agree	Disagree	Strongly disagree	Total
Getting certified helps mobilize staff	12	82	1	0	100

Certification is an external recognition of the efforts made	88	12	0	0	100
Being certified allows you to gain new customers	65	23	12	0	100
Being certified avoids losing customers	59	29	12	0	100
Certification improves the image of the company	82	18	0	0	100
Certification makes it possible to stand out from the competition	82	18	0	0	100
Certification brings advantages to export	88	12	0	0	100
Certification helps reduce non-quality costs	88	12	0	0	100

Table 8: Contributions of the certificate

	Considerable	Important	Weak	Total
Percent	18	70	12	100

Conclusion:

The results of the survey show that the reasons for adopting ISO 9001: 2000 certification are to put in place a better organization, reduce the costs of non-compliance and meet customer expectations. ISO 9001: 2000 certification provides the company with external recognition of the efforts made, improves the company's brand image, allows the company to differentiate itself from the competition, provides export advantages and allows reduce the costs of non-compliance. It also gives other benefits, such as gaining new customers and mobilizing staff. The certification has also helped the company to maintain itself in its traditional markets and even helped it to enter new markets. These are the conclusions of the interviewees.

ISO 9001: 2000 certification brings benefits to the companies involved in the investigation. They range from improving business performance (external benefits) to improving the organization (internal benefits). These are here conclusions on the perceived benefits of certification on companies that have a certificate.

The question to ask is what is the performance of companies that have not opted for certification. It is a question of carrying out, of carrying out a comparison of the performances of certified companies of those which do not have one.

Based on the perception of managers of certified companies, this study does not provide any answers on the real benefits of certification. This first work, which only sheds light on the status of certification in the company

Algerian food industry, could nevertheless serve as a preamble for possible studies on the results and impact of ISO 9001: 2000 certification.

Bibliographical references:

[1] BOÉRI D. 2006, «Maîtriser la qualité. Tout sur la certification (normes ISO 9001 : 2000 la qualité totale et le management éthique », ed. Maxima, Paris, p. 392.

- [2] BEATTIE K. R., SOHAL A. S. 1999, “Implementing ISO 9000 : A study of its benefits among Australian organizations” in *Total Quality Management*, Vol. 10, Iss. 1, p. 95 106
- [3] CATTAN M. 2003, «Pour une certification qualité gagnante. Avant – Pendant – Après», ed. AFNOR, SaintDenisLaPleine, p. 309.
- [4] CASADESUS M., GIMENEZ G., HERAS I. 2001, “Benefits of ISO 9000 implementation in Spanish industry” in *European Business Review*, Vol. 13, Iss. 6, p. 327336.
- [5] ESCANCIANO C., FERNANDEZ E., VAZQUEZ C. 2001, “ISO 9000 certification and quality management in Spain: Results of a national survey” in *The TQM Magazine*, Vol. 13, Iss. 3, p. 192200.
- [6] HOYLE D. 2006, “ISO 9000 Quality Systems Handbook”, Fifth Edition, ed. Elsevier, Oxford, p. 699.
- [7] JAUPI L. (2002), “Contrôle de la qualité. MSP Analyse des performances. Contrôle de réception”, ed. Dunod, Paris.
- [8] LIPOVATZ D STENOS F.AND VAKA A. (1999), “Implementation of ISO 9000 quality systems in Greek enterprises” in *The International Journal of Quality & Reliability Management*, Vol. 16, Iss. 6, p. 534551.
- [9] TERZIOVSKI M., POWER D., SOHAL A.S. 2003, “The longitudinal effects of the ISO 9000 certification process on business performance” in *European Journal of Operational Research*, Volume 146, Iss. 3, pp. 580595.
- [10] TERZIOVSKI M. POWER D 2007, “Increasing ISO 9000 certification benefits : a continuous improvement approach” in *The International Journal of Quality & Reliability Management*, Vol. 24, Iss. 2, p. 141163.
- [11] ISO 2008, «Les caractéristiques essentielles d’ISO 9000» in http://www.iso.org/iso/fr/iso_catalogue/management_standards/iso_9000_iso_14000/iso_9000_essentials.htm).
- [12] The ISO survey of management system standard certifications – 2019

Retail Therapy And Its Effects In Contemporary Marketing And Management

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Abstract

Shopping or purchase is a daily practice of all consumer groups. The effects of purchasing are reflected through consumer behavior in the market and through other factors that influence the purchase and behavior. The retail therapeutic impact and effect refer to the whole spectrum of external and internal factors that have an impact on consumer behavior in private life as well as in business systems.

The aim of this paper is to determine whether the retail really has a therapeutic effect on all consumers, both male and female population. The goal is also to determine whether all consumers, regardless of gender, have positive attitudes towards purchase and its effects.

Satisfaction after shopping is both economic and socio-psychological topic and has an impact on individuals and groups in marketing and management systems.

Keywords: purchase, consumer, marketing, management, retail therapy

Jel: M11, M31, D12

PREFACE

Shopping or purchase, causes different feelings and affects consumers. Everyone can relate to the sheer joy that buying a little something brings happiness and satisfaction.

"Most of the joy that occurs when shopping has its cause in dopamine, a chemical in the brain that affects people's mental and psychological health. Dopamine is associated with feelings of contentment and satisfaction and is released into the brain when people experience something exciting and challenging."³

When we talk about the therapeutic impact of shopping, we are talking about the fact that shopping has a positive impact on those people who like shopping and who purchase a lot. At the same time, it represents a purchase that has a positive effect on consumers' mood and on the feeling of satisfaction and happiness.

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³ Chapter 51: The Science of shopping, *Consumer Behavior*, Richard K. Miller & Associates, 2007, 249–252.

There are various controversies and numerous researches that have dealt with individual segments of this topic, and some of them are presented further in this paper.

The therapeutic impact of shopping is an interesting and somewhat exotic topic for marketing and management professionals.

RESEARCH METHODOLOGY

Respondents

The research was conducted on a sample of 212 respondents during 2012 in the Republic of Srpska within the part-time students.

Variables

The research was conducted by using a survey which contains several parts and attitudes, and the specific attitudes related to the assumption of this paper are as follows:

Question or attitude that connects the levels of purchase satisfaction of male and female consumers:

-Shopping/purchase has a positive effect on consumers' mood and has a therapeutic effect in terms of raising self-confidence and improving mood.

Research method

The research was conducted by survey that contained answer suggestions in the form of the Likert scale: I strongly agree, I agree, I partially agree, I disagree and I strongly disagree.

The premise of this paper is that purchase has a therapeutic impact on consumers.

RESULTS AND DISCUSSION

People often buy when they are abroad, when they travel, which is related to the excitement around traveling. In most cases purchase is impulsive, which is good for those who sell those goods. As long as there are impulsive consumers, companies that deal with sales and these types of services will have business success.

"One study found that about 40% of consumers make impulsive purchase.⁴"

The first questions that are asked in many articles and researches by economists are: Can money buy happiness?

⁴Chapter 51: The Science of shopping, *Consumer Behavior*, Richard K. Miller & Associates, 2007, 249–252

"Can money buy happiness?" Well, yes, in a way. But not really, or at least not always.⁵

The famous economist Richard Easterlin was the first to write about wealth and happiness in the 70's. The distinguished professor worked at the University of Pennsylvania as an economist. His researches were based on the observation that people living in wealthier countries are happier than those living in poorer countries. It was a clear question but it was not clear and it was not easy to determine whether money leads to happiness on an individual level. Subsequent researches have shown that what is really important is the "relative health or well-being" of people. Then, a new study by two eminent economists from the University of Pennsylvania showed that money and happiness are related all around the world.

As one blog post on the New York Times website writes⁶:

- 1- Wealthy people are happier than poor people;
- 2- Wealthier countries are happier than poorer countries;
- 3- As the country becomes richer, it becomes happier;

At the University of British Columbia - Harvard Business School, one study presented new evidence that people with more money pretend to be happier. But, this study has shown and found that those who give a part of their wealth further reach the greatest happiness.

„The opportunity to donate money is a luxury that inspires. Money is associated with happiness because it enables power and freedom. What people will do with that power and freedom, depends on their personal values.⁷“

In one study that explored the connection between money and happiness and things that are bought in the consumer satisfaction context, it is claimed that "money cannot buy happiness, but it can buy many things that bring happiness."⁸

According to a relatively recent study by psychologists, people who spend money on food, travel and other experiences tend to be more open and adventurous than those who spend money only on material things.

A study conducted in China investigated individual consumer satisfaction and retail and use of cars as a link to the social indicator as the general good of the individual. The study showed that the ability to afford larger assets and more household assets such as a car that meets needs and produces satisfaction, it evokes a sense of happiness and a sense of the common good of the individual. This feeling of happiness occurs in the context of the society in which these people live as well as in the context of satisfaction with the politics of the national economy.

⁵ Maich, S., It's official: money buys happiness. Maclean's. 2008, May 5, 39.

⁶Maich, S., It's official: money buys happiness. Maclean's. 2008, May 5, 39.

⁷ibidem

⁸Rubin, G., happy days!. Woman's Day, 73(7), 2010, 18.

Impulsive shopping is often associated with purchase satisfaction. Each purchase that is impulsive is not planned and as such is based on feelings, excitement and stronger instincts than in other forms of purchase.

A study that has been conducted is related to impulsive shopping. In that research, the goal was to see how the presence of other people affects shopping. The results of two experiments showed that peers presence increases the urge to shop, while the presence of family members reduces that urge.

Shopping and satisfaction after purchase as well as the therapeutic impact of shopping are very interesting topics that are reasonably related and they need more attention from the marketing aspect. A study conducted in the UK and published in an American magazine for psychology and marketing showed that shopping really has a positive effect on human mood. By going shopping, we suppress negative feelings and make ourselves happy, wrote the Daily Mail.

This conclusion is based on hundreds of interviews conducted in various malls. Customers were asked to keep diaries of their behavior and mood during shopping - whether they felt guilty or remorse later. 62 percent of them confirmed that they bought something to improve their mood, while 28 percent of them reached out to buy to reward themselves for something, reports Net. Feelings of guilt and remorse were reported only by those who reached for unplanned purchase.

Retail as therapy

The therapeutic impact of the purchase was analyzed through the conducted research.

In this sense, the assumption we prove is that retail has a therapeutic effect in the form of raising the consumers' mood and self-confidence. The strength of the influence on the respondents' feelings is measured by the level of satisfaction or lack of comfort due to unmet need, and it is measured and expressed through concrete empirical data where we test the assumption that over 60% of the total number of respondents feel the positive effects of "shopping" which improves their mood and raises their self-confidence.

- X_1 – expresses the impact of shopping on respondents' self-confidence and mood;
- X_2 –expresses the impact of compensatory measures in case of lack of purchase funds;
- X_3 –expresses the impact that absence of purchase has on the respondents' mood and self-confidence.

Satisfaction measurement takes into account five levels of satisfaction in respondents adjusted by empirical material. The presence of pleasure is defined through the value of satisfaction levels 3 and higher. Starting from specific data, the empirical distribution shown in Table 1 is formed.

Table 1. EMPRIC SERIES - intensity of purchase influence on the respondents' mood classified by gender

Satisfaction intensity	FEMALE			Respondents	MALE			Respondents
	X ₁	X ₂	X ₃		X ₁	X ₂	X ₃	
5	1	10	7	18	7	17	13	37
4	8	44	38	90	19	43	31	93
3	43	31	40	114	25	18	31	74
2	39	18	17	74	33	22	19	74
1	17	5	6	28	20	4	10	34
Σ	108	108	108	324	104	104	104	312

It is important to point out that in Table 1. the intensity of satisfaction is marked from 1 to 5, where 5 is the highest level of satisfaction, while the marks X1, X2 and X3 connect respondents with the satisfaction intensity in different ways.

It can be seen that with both, women and men, satisfaction level is formed mostly by the values of satisfaction intensity 3, 4 and 5.

The tabular value for the selected reliability degree of the derived conclusion is 95% and is $z(0.05) = 1.65$ and it is valid equally for testing the percentage of female and male participation.

The test value of the sample proportion is:

$$\text{For female respondents } z = \frac{0,68-0,60}{0,0272} = 3,13$$

$$\text{For male respondents } z = \frac{0,65-0,60}{0,0157} = 3,42$$

By comparing the tabular and test values, we draw conclusions about the set hypotheses. In this particular case, it is easy to see that the tabular value is lower than the test value ($1.65 < 3.13$ - in relation to the female population and $1.65 < 3.42$ - in relation to the male population). The test result suggests that it is justified to reject the testing hypothesis in both cases, and it can be said that over 60% of the total number of respondents feel the positive effects of shopping, which improves respondents' mood and self-confidence. This confirms the hypothesis: Purchase has a therapeutic effect on all consumers, both female and male population.

The test result explains that respondents, regardless of gender, feel the therapeutic effect of "shopping" in a percentage above 60%. The rating was performed with 95% reliability.

CONCLUSION

The purchase has a therapeutic effect on all consumers, on both, male and female population.

The test result explains that respondents, regardless of gender, feel the therapeutic effect of "shopping" in a percentage above 60%.

Shopping and satisfaction after the purchase as well as the therapeutic impact of the purchase are very interesting topics that are reasonably related and they need more attention from the marketing aspect as well as from the system management.

LITERATURE

1. Branko R. Maričić, *Ponašanje potrošača, marketinški pristup*, drugo dopunjeno izdanje, Savremena administracija, dd Izdavačko-štamarsko preduzeće, Beograd, 1993
2. Chapter 51: The Science of shopping, *Consumer Behavior*, Richard K. Miller & Associates, 2007
3. Kotler Philip, Kevin Lane Keller, *Marketing menadžment*, 12. Izdanje, preveli Zoran Bagdetić, Mirjana Gligorijević, Ekonomski fakultet, Univerzitet u Beogradu, Beograd, 2006.
4. Kotler Philip, *Marketing menadžment*, The millenium etidion, Prentice-Hall International Inc, Upper Saddle River, New Jersey, 2000
5. Maich, S., It's official: money buys happiness. Maclean's. 2008
6. Rubin, G., happy days!. Woman's Day, 73(7), 2010

Virtual Reality- Modern Innovative Techniques for Education

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ABSTRACT

Training that takes place over the Internet is referred to as online teaching and learning. COVID-19 pandemic made us aware of a totally new concept which is now widely acceptable throughout schools and colleges in India. Many colleges in India and abroad are transitioning from conventional face-to-face classes to completely immersive, web-based courses. Online education, also known as distance education or web-based education, is the most recent and widely used form of distance education. Many academic programmes have recently included it as a requirement [6]. But every new technique comes with its own challenges. The aim of this paper is to provide a brief overview of the innovative techniques such as Virtual Reality (VR), that can be applied in online teaching and learning. This will also pave a way for the different techniques applied to solve the various challenges. We present new opportunities in VR and recent virtual reality tools and applications used in education [2].

KEYWORDS

Innovative Teaching Learning, ICT, VR, Unity 3D

1. INTRODUCTION TO THE CURRENT SCENARIO

As the landscape of higher education continues to evolve, quality teaching has become increasingly important. Both socially and geographically, the student body has grown and diversified significantly. New students necessitate new teaching techniques [1]. Technology has advanced in recent years. As a result, the essence of the relationships in the classroom has changed.

India has one of the world's most extensive and diverse educational systems. Access to higher education has improved as a result of privatisation, widespread expansion, enhanced autonomy, and the implementation of programmes in new and developing areas. The fundamental issue is that Quality Teaching

lacks precise definitions and is inextricably linked to arguments about quality and quality culture in higher education, all of which are still contentious concepts. Some scholars consider quality to be primarily an outcome, while others consider it to be primarily a property. Some people believe that teaching is a never-ending process of removing flaws, and that Quality Teaching can never be fully understood and evaluated [3].

One technology that is pushing its way into the mainstream is virtual reality (VR), defined as immersive, realistic, three-dimensional environments that involve visual feedback from body movement. There is evidence that VR can address the above online educational challenges. VR can: lead to increased student engagement; provide active, constructivist learning; increase frequency of authentic learning experiences; allow for empathetic experiences; enable students to exercise creativity; and provide an arena for visualising abstract concepts concretely.

In this paper we discuss problems in online education and how those challenges can be overcome using Virtual Reality. Next we present a case study to discuss how VR can lead to new opportunities in online education. Finally we conclude the discussion.

2. RELATED WORKS

In recent years, online learning has changed the face of education by becoming a supplement to traditional methods, allowing people to learn at a distance, on their own time and at their own pace. Virtual Reality (VR) has become a powerful tool for educators to expand their reach while providing students with a way to get an education without having to step foot into a classroom.

The application of virtual reality in Engineering Education[1]:

In this paper they reviewed that VR has positive cognitive and pedagogical benefits in engineering education, which ultimately improves the students' understanding of the subjects, performance

and grades, and education experience. In addition, the benefits extend to the university/institution in terms of reduced liability, infrastructure, and cost through the use of VR as a replacement to physical laboratories. Also have selected the constructivist and variation learning theories as they are currently successfully implemented in engineering education, and strong evidence shows suitability of implementation in VR for education.

Augmented Reality and Virtual Reality in Education, Myth or Reality [2]:

This paper stated that an actual integration of these technologies requires lots of improvements and changes not only on the part of engineers and experts of AR and VR, but also teachers and all persons related to the field of education. These technologies can create enhanced contemporary educational environments and enriched learning opportunities for students.

Immersive virtual reality to enforce teaching in engineering education [3]:

In this paper authors use VR with Project-Based Learning (PBL) in a self-directed approach to design and implement a product using 3D software whilst also using virtual reality immersive CAVE display to evaluate their design. In addition, the course outcomes related to project design were better achieved in the VR approach. The communication and problem-solving skills were improved in the VR approach as compared to the traditional approach.

Innovations in teaching methods [4]:

This paper reviews various approaches of teaching learning like Constructive Methods, Demonstration, Discussion, Story Telling, Role Play, Visit, Project, Laboratory, Assignment, Quiz, Problem Solving, Dialogue, Question Answer, Seminar and Conference method, Lecture with PowerPoint Presentations, Flip Class, Lecture with Audio and Video presentations, Online Teaching etc. Also suggested that the transfer of textual learning contents to visual learning content is important. This transition is more effective in the learning through innovative and effective teaching methods.

The importance of modern innovative teaching methods in the higher education system of Uzbekistan [6] :

This paper highlights the importance of modern innovative teaching methods in the higher education system of Uzbekistan. Also mentions the importance of new techniques of education, the students should be able to develop mental, free thinking, strive to substantiate their own opinion, listen to the opinions of others, try to find solutions to problems, and effectively affect the processes of creative and moral development.

3. PROBLEMS IDENTIFIED IN ONLINE TEACHING

In a traditional classroom or lecture, you learn by listening to your teacher and talking to classmates. There is usually a specific time and location for these classes. With online learning however, you can be anywhere in the world and still

receive the same high quality teaching as someone who is there in person.

Online learning is typically conducted through the internet, as a series of courses you can access anytime, anywhere. Socializing and asking questions is done through discussion forums or via email. There are a number of key benefits of online learning, but we can not ignore the difficulties faced by students during online classes. Few are listed below.

3.1 Barriers to Online Teaching

There is a plethora of positive information about online education with some very obvious advantages. However, most students are still choosing traditional classes - why is this? There are still several big drawbacks to online education in comparison to traditional classroom education.

1. **You need to be self-disciplined:** Online courses usually have deadlines for assignments so the time management is necessary to complete tasks.
2. **Low retention and completion rates:** Due to the low cost of online courses and training programs, there is less incentive to complete them. Some students might indeed only need to learn about certain topics on the course and therefore never intend to complete the whole of it.
3. **Require good time-management skills:** Online courses require the self-discipline to make online studying a priority and not let other activities interfere.
4. **Lacks the social aspect of regular classes:** The social aspect of regular classes is an important part of learning. Getting stuck on problems and asking classmates, group work and other group based activities help people learn more efficiently and provide a collaborative environment. It's hard to recreate this social aspect with online learning.

3.2 Contributions of VR in the field of online education

Experiential learning is a process of learning through first-hand experience. It's a method of gaining expertise and skills through the practical application of concepts, theories and problem solving techniques instead of just reading or hearing about them.

Here are some of the benefits of experiential learning with VR:

1. **Accelerates learning** - repetitive learning or learning by rote can be dramatically improved by actually performing or visualising the learning material. VR learning uses problem solving, powerful visualisation,

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decision making and other elements to enhance the learning experience.

2. **Provides a safe learning environment** - it is only natural that mistakes happen during the course of learning, and using VR simulations lets people learn in a safe controlled environment. Students can therefore try different approaches and understand for themselves what works best.
3. **Bridge the gap between theory and practice** - students often learn textbook theory about a certain topic, experiencing this theory in an interactive 3D environment gives students a more memorable learning experience.
4. **Increases engagement levels** - the virtual world lets students collaborate and learn from each other, increasing overall engagement with a tangible outcome result.
5. **Assessing complex learning is easier** - VR can simulate a range of complex topics, from brain surgery to gravity, bringing the learning process to life.

We have explored a VR tool, Unity 3D for the above said purpose.

4. OBJECTIVES

The major objectives behind this study is:

1. To investigate the significance of high-quality instruction under online mode.
2. To learn about new methods and strategies to be adopted for interactive teaching learning in an online model.
3. To explore the use of VR tools in effective teaching learning processes.

5. INTRODUCTION TO UNITY 3D

Unity 3D is an all-in-one mobile game creation platform. It has sparked a lot of interest among game makers because of its unique features, affordable cost, and competitive structure. With its capacity to operate as a cross-platform app development tool, it saves creators time that would otherwise be spent designing games for different platforms. Unity is excellent for cross-platform development. It is also more user-friendly than many other technologies. There are numerous additional complex technologies that become more difficult as we use them. Here, there is an exception: unity. One of the most significant advantages of Unity is its cost effectiveness. Unity has its own IDE which reduces complications during designs.

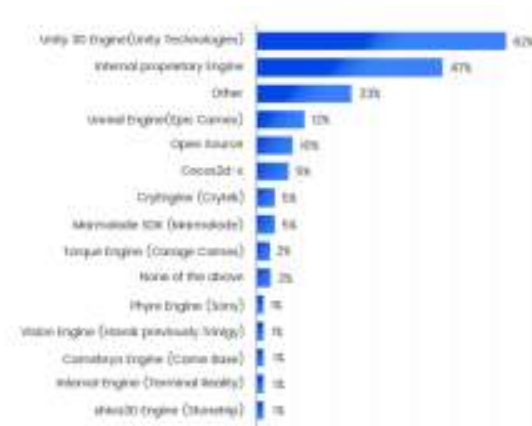


Fig 1: Statistics showing the use of Unity 3D in creating animations as compared to others.

The above statistics show that Unity 3D is more developed and is being used very frequently in animation/game development.

6. NEW PEDAGOGICAL TECHNIQUES IMPLEMENTED USING VR

Case Study: Data Structures

Data Structure is a way to store and organize data so that it can be used efficiently. The data structure name indicates itself that organizing the data in memory.

Problem:

The traditional teaching methods are not dynamic and are not effective for students to understand difficult topics. These methods consume a lot of time to make an individual learn a topic.

Solution: Learning Hub

As the name suggests, 'Learning Hub' is a e-learning initiative where we have created a website which consists of topics related to Data Structures where we have explained the basics of Data structures by providing notes and labelled diagrams. Stack, Singly linked list, Doubly linked list, Circular linked list, Simple queue, Circular queue, Trees are the particular topics on which we have focused. To top it off, we have uploaded our video animations on YouTube and we have also embedded them on our website.

Results and Snapshots of Implementation

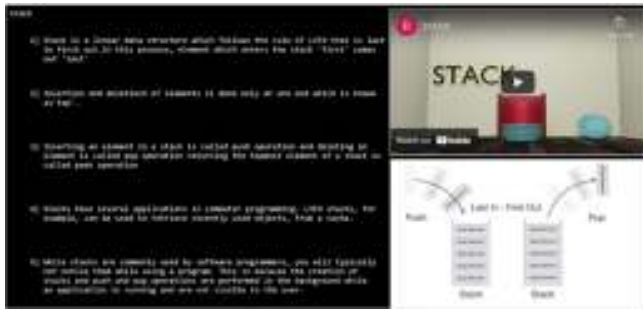


Fig 2: 3D implementation of Stacks

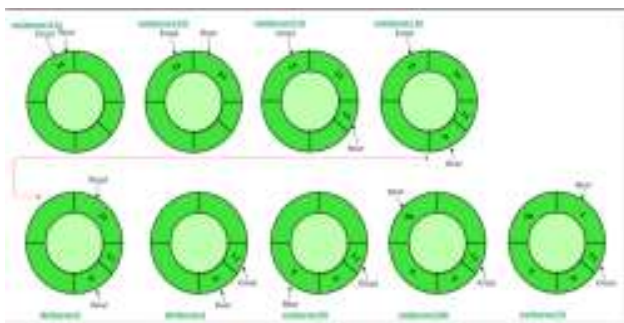


Fig 3: Circular Queue

7. CONCLUSIONS AND FUTURE WORK

The education system has been evolving for centuries. It has always adapted to the available technology and needs of the students. We are now on the threshold of another development and it is a duty of scholars, educators and teachers to embrace it and prepare for it. Modern technology like VR, if used in the classroom increases engagement, stimulates cooperation and involvement. It is used for highly efficient blended learning, encouraging self-study and individual pursuit of knowledge[5].

The bits of knowledge which can as a part of modern innovative teaching learning techniques, we tried to create and develop animations and presented them through a website which will help students to get their basic concepts clear in core computer engineering subjects like Data Structures. We mined from such a lot of information can empower organizations to develop at a pace based on their personal preference, be it long haul objectives or momentary objectives[5]. Here, we were able to do 3D animations for only stacks and queues using Unity 3D. 2D animations for all the other data structures were developed. Future work tends to create 3D animations for all the other data structures. Real life examples are always good for students which helps them in understanding concepts easily.

REFERENCES

- [1] Maged Soliman, Apostolos Pesyridis, "The application of virtual reality in Engineering Education", MDPI Journal of Applied Science, March 2021,
- [2] Nouredine Elmqaddem, "Augmented Reality and Virtual Reality in Education, Myth or Reality?", IJET Vol 14 Issue 3, 2019
- [3] Osama Halabi, "Immersive virtual reality to enforce teaching in engineering education", Multimedia tools and application, 2018
- [4] M Vijayalakshmi, "Innovations in teaching methods", JASC, 2018
- [5] Ram Tirath, "A study of Innovative Teaching Methods for state of the art education in India", IJBAM, Volume 7, Number 1, 2017
- [6] Urinboyev Hoshimjon Bunatovich, et al. "The importance of modern innovative teaching methods in the higher education system of Uzbekistan", Journal of critical Reviews, 2020
- [7] Farah Naz and Hasan Sohaib Murad, "Innovative Teaching has a positive impact on the performance of diverse students", SAGE Open, 2017
- [8] Elliot Hu-Au, Joely Lee, "Virtual Reality in Education: a tool for learning in the experience age", International Journal for Innovation in education, 2018

Role of Ict and Social Capital in the Development of New Tourist Destination

A.Y. Agung Nugroho, Suharsono, Alfonso Harrison

Abstract— Regional autonomy in Indonesia encourages local governments to create new tourist destinations. These new tourist destinations are usually developed in remote areas with limited infrastructure and target the local tourist market. Previous studies show that it is necessary to boost the use of ICT in promoting and developing new tourist destinations and involving the community and utilizing the social capital of local communities. The purpose of this study is to identify the role of ICT, community involvement, and social capital in the development of new tourist destinations, with a case study of tourist destinations in Pringsewu Regency, Lampung. This study uses a qualitative approach with in-depth interviews with regulators, tourist destination managers, community groups, and visitors. It added with focus group discussions (FGDs) involving tourism business managers and tourism-conscious communities, and finally, the data were analyzed descriptively and critically using a triangulation technique. The results showed that ICT plays an essential role in promoting new tourist destinations because of its effectiveness in reaching prospects through social media. The study also revealed that a tourism support community group is an enabling factor that becomes a catalyst to connect destination managers with stakeholders such as local governments, supporting businesses, and local communities. This connection through regular meetings between stakeholders is an essential aspect of social capital in developing new tourist destinations, namely increasing the spirit of cooperation (gotong-royong) which is the norm and value of the Indonesian community. It also provided trust among stakeholders and built higher quality networking between regulators, communities, destination managers, and other tourism supporting business actors.

Keywords— ICT, Local Community Involvement, Social Capital, Tourist Destination.

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An AI-based Algorithm for Rapid Influenza Diagnosis with Imperfect Tests

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Abstract –

Intro: Rapid influenza diagnostic testing (RIDT) is a standard medical procedure that can identify the presence of influenza viral nucleoprotein antigens in respiratory specimens. The RIDT can yield results in a relevant time frame, namely, from 15 to 30 minutes. However, the RIDT results have a potential for false negative and false positive outcomes. Assume that an influenza infected person is hidden in a group of healthy people. Rapid diagnostic tests are carried out in order to quickly detect the infected person. Two types of testing errors can occur, namely, false-negative and false positive outcomes. The goal is to schedule the tests so that to detect the infected person as fast as possible. **Finding:** The model expands the search scenarios in which only the overlooking error occurs. A novel fast AI-based search algorithm is found and justified.

Key words - AI-based algorithm; false-negative and false-positive outcomes; rapid diagnostic tests; search with imperfect tests.

I. INTRODUCTION

Rapid influenza diagnostic testing (RIDT) is a standard medical procedure that identifies the presence of influenza viral nucleoprotein antigens in respiratory specimens and display the result in a qualitative way, positive vs. negative [13,15]. The RIDT can yield results in a clinically relevant time frame, namely, from 15 to 30 minutes. However, the RIDT results should be interpreted with caution given their potential for false negative and false positive outcomes, especially during an influenza peak period.

Assume that an influenza infected person is hidden in a group of healthy people. Rapid diagnostic tests are carried out in order to detect the infected person (called “a target”). Two types of testing errors can occur, namely, false-negative and false positive outcomes. The goal is to schedule the tests so that to detect the infected person as fast as possible. The model that we suggest, expands the search scenarios in which only the overlooking error occurs. A novel fast AI-based algorithm is found and justified.

The discrete search problem is an ancient optimization problem having many applications. The mathematical model in this paper expands earlier known discrete search models in which only the overlooking of target is taken into account. For the general survey on search theory, we refer to Alpern et al. [2] and Washburn [14].

The discrete search for the hidden targets has been extensively studied in the literature for many years. Among numerous other applications of this

problem, we can mention the search-and-rescue in military and emergency situations, the optimal search for hidden hostile objects, control and inspections of critical/failed components in complex systems, etc.

One of the early known results is the following. To minimize the expected cost of detection, the optimal policy is to inspect, at any time, the location with the largest current *attractivity index* that depends on the parameters of the location and is updated after each unsuccessful search (the exact value of the attractivity index will be discussed below). This result is attributed to Blackwell (see Matula [9]). Kadane [5] have showed that a similar greedy policy ensures the maximum probability of finding the target within any fixed number of inspections. During the past decades, various optimization versions of the discrete search problem with a single target or multiple targets, with a single or multiple imperfect tests, have been studied, and different solution methods have been proposed (see, e.g., Atkinson et al. [3], Kadane [5], Kress et al. [6], Kriheli et al. [7], Levner [8], and Ross [12]).

Many of such problems can be effectively solved by greedy algorithms using the interchange argument (IA), see, e.g., [1], [4-8], [10-12]. However, in a more general situation, when the imperfect tests may have two types of errors, false-negative and false-positive, the standard interchange-based greedy algorithms are invalid for solving the problems. The main aim of this research is to overcome this deficiency and effectively solve the problem using an Artificial Intelligence (AI) approach.

We propose a new two-stage algorithm extending the standard interchange-based algorithms. During the initial (preparatory) stage, the algorithm performs a linear number of preliminary steps aimed to collect available data about infected people in the considered population. Then the algorithm proceeds to the main stage, wherein all the potential individuals are inspected sequentially using the new greedy procedure; in this algorithm, in contrast to earlier known search procedures, the proposed greedy rule at each step directly uses the earlier-obtained knowledge and thus strongly

depends on the computational results of the preceding steps. The stopping rule and all the details of the algorithm are explained below.

The rest of this paper is organized as: Section 2 presents main definitions and basic properties of the search problem with two types of errors. In Section 3 we examine the linear time/cost objective function and present sufficient conditions for the AI-based greedy strategy be optimal. Section 4 concludes the paper.

II. PROBLEM DESCRIPTION

A basic search problem is formulated as follows. An infected person referred to as an *target*, is hidden within a finite set I of possibly infected people, with an a priori probability p_i ($\sum p_i = 1$, $i \in I$), for each person, the number of the whole population being $|I|$. Associated with each person i , $i \in I$, besides of the probability p_i , are the following data:

- a cost (or time) c_i for inspecting/searching person i ;
- an “overlook probability” α_i , i.e., the probability that if the target is the person i and if the imperfect test inspects the person i once, it (the test) *does not discover* the target; in this case we say that there is sensor’s type-I error, or a false-negative outcome.

The problem is to find a sequential strategy (i.e., sequence) $\pi = [\pi(1), \pi(2), \dots]$, where $\pi(k)$ is an individual searched at the k th step in π , such that the expected cost/time $V(\pi)$ of finding the infected person is minimal. Note that, theoretically, since the tests are imperfect, before the target can be successfully found, any potential individual may be tested in the worst case infinitely many times.

Consider the input data in more detail:

- event $C_i = \{\text{the person } i \text{ is exactly the target}\}$;
- $P(C_i) = p_i$, a priori probability that the target is the person i ;
- event $B_i = \{\text{during a single test of person } i, \text{ the test has classified the observed person as a target, or, in other words, during a single test of an } i, \text{ the computer test claims that the target is detected and this is this person}\}$; in fact, test’s latter claim can be either correct or false depending on whether or not the person i is ill;
- event $B_i^{(j)} = \{\text{during the } j\text{th (sequential) repeated testing of person } i, \text{ the test claims that the target is detected as person } i\}$;

- $\alpha_i = P(\bar{B}_i | C_i)$, the probability that the test (incorrectly) claims that the target is *not* the i under condition that the target is actually the i ; this is the overlook probability mentioned above, also called the type-I error, or a false-negative outcome;
- $\beta_i = P(B_i | \bar{C}_i)$, the probability that the test erroneously classifies a person i as the target when testing the i (although, in fact, the person i is *not* ill); this is the false-positive probability, also referred to as the probability of the type-II error.

Along with the above, the following parameters are introduced depending on the above-mentioned probabilities:

- $f_i = P(B_i)$, the probability that the imperfect test claims (either correctly or incorrectly) that the target object is the person i as a result of the single testing this person;
- $d_i = P(B_i | C_i)$, the conditional probability that, during a single test of a person i , the test correctly detected that the person i is infected under condition that the target is really the person i ;
- $g_{[i,1]} = P(C_i | B_i^{(1)}) = P(C_i | B_i)$, the conditional probability that the target is really the i under condition that this person is correctly classified as the target by the tests of person i ;
- $g_{[i,h_i]} = P(C_i | B_i^{(h_1)} \cap B_i^{(h_2)} \cap \dots \cap B_i^{(h_{h_i})})$, the conditional probability that the person i is really infected under condition that this person is (correctly) detected to be infected during h_i sequential tests of the i , the integer number h_i being known; the values h_i, j_1, j_2, \dots will be defined below.

The following parameters will be used:

- CL , a *confidence level*, defined by the decision makers as a permissible threshold (a lower bound) for the probability $g_{[i,h_i]}$:

$$g_{[i,h_i]} \geq CL; \quad (1)$$

- H_i , the minimum number (*min* h_i) of sequential inspections of person i required for the probability $g_{[i,h_i]}$ to satisfy the inequality (1):

$$H_i = \min(h_i) | g_{[i,h_i]} \geq CL.$$

The following formulas directly follow from the total probability formula and Bayes’ formula.

Proposition 1. $f_i = P(B_i|C_i)P(C_i) + P(B_i|\bar{C}_i)P(\bar{C}_i) = (1 - \alpha_i)p_i + \beta_i(1 - p_i)$;

$$g_{[i,1]} = P(C_i|B_i) = \frac{P(B_i|C_i)P(C_i)}{\frac{P(B_i|C_i)P(C_i) + P(B_i|\bar{C}_i)P(\bar{C}_i)}{(1-\alpha_i)p_i}} = \frac{p_i(1-\alpha_i)}{p_i(1-\alpha_i) + (1-p_i)\beta_i}$$

We assume that the sequential inspections of peoples are independent. In order to efficiently find the H_i values, we need the following claims:

Proposition 2. The integer number h_i being given, the conditional probability $g_{[i,h_i]}$ can be found as follows:

$$g_{[i,h_i]} = P\left(C_i \left| B_i^{(h_i)} \cap B_i^{(h_i)} \cap \dots \cap B_i^{(h_i)} \right.\right) = \frac{p_i(1-\alpha_i)^{h_i}}{p_i(1-\alpha_i)^{h_i} + (1-p_i)\beta_i^{h_i}}$$

Proposition 3. For all $i, i \in I$, the function $g_{[i,h_i]} = F(h_i)$ is monotonically increasing in h_i .

A pre-determined value of the confidence level, CL , being given, for any i , the *height* H_i is defined as a minimal integer h_i satisfying the following condition (1).

Proposition 4. For any location i , the H_i = minimum h_i value can be found straightforwardly as follows:

$$H_i = \left\lceil \frac{\log\left(\frac{p_i}{1-p_i} \cdot \frac{1-CL}{CL}\right)}{\log\left(\frac{\beta_i}{1-\alpha_i}\right)} \right\rceil$$

where $\lceil x \rceil$ denotes the ceiling value of a real number x , that is the smallest integer number following x .

The above formula directly follows from Propositions 2-3 and the following relation:

$$g_{[i,H_i]} = P\left(C_i \left| B_i^{(1)} \cap B_i^{(2)} \cap \dots \cap B_i^{(H_i)} \right.\right) = \frac{p_i(1-\alpha_i)^{H_i}}{p_i(1-\alpha_i)^{H_i} + (1-p_i)\beta_i^{H_i}} \geq CL. \quad (2)$$

The proofs of Propositions 1-4 are evident and omitted here.

The stopping rule. We assume that the searching process is allowed to stop as soon as the probability of the successful detection $g_{[i,h_i]}$ for some person reaches the pre-determined confidence level CL . In other words, the search stops as soon as the bounding inequality (1) becomes valid for some person, the CL value being given in advance. Hence, the search of the target finishes when the repeated tests discover that a person i is a target exactly H_i times, $i \in I$. To summarize, in the considered search model with the errors of two

types we assume that the search may be (successfully) finished as soon as the probability of the correct detection of the target, $g_{[i,H_i]}$, for some person i will be no less than the required confidence level, CL .

The relation (2) and the above stopping rule display the principal difference with the Matula search model. Namely, in the latter model the search of the target is assumed to be successful (and the search process stops) as the test claims that it detects the target *for the first time*, - and after this the process stops. In contrast, in the present work the search process is based on the AI ideas and continues after the first detection of the target; it stops only when the target is discovered sufficiently many (H_i) times to be a person i , guaranteeing that the probability of the correct discovery of the target reaches a sufficiently high value, CL , given in advance. A numerical example in Section 3 demonstrates that the probability of the correct discovery of the illness in the latter case may be considerably higher than the corresponding probability in the models that ignore the false-positive inspection outcomes.

III. AN AI-BASED ALGORITHM

Consider the following sequential search strategy $\pi = \{U_{\pi[0]}, \pi[1], \dots, \pi[n], \dots\}$, where $U_{\pi[0]}$ is an initial sub-sequence that contains any of the locations i exactly H_i-1 times, for example, the following one:

$$U_{[\pi,0]} = \left\{ \underbrace{1,1, \dots, 1}_{H_1-1 \text{ times}}, \underbrace{2,2, \dots, 2}_{H_2-1 \text{ times}}, \dots, \underbrace{m, m, \dots, m}_{H_m-1} \right\} AI - based$$

The meaning and role of the above sub-sequence is to provide that the AI-based algorithm remembers and uses a preliminary information collected at the early steps of the testing procedure. It will be explained below, after that we formulate the objective function properties.

We need the following additional notation:

- $M(i, N, \pi)$, the number of inspections of person i among the first N inspections in sequence π ;
- $\pi(N) = i$;
- t_i - the time spent for testing once the person i ;

- $P_i = P(i, N, \pi) = P(M(i, N, \pi))$, the probability that the test discovers that the target is the person i exactly H_i times during N first steps of sequence π ,
- c_i - the time (or cost) assigned to a single testing of person i in the linear min-cost (min-time) search model;
- $V(\pi)$, the total search time (cost) assigned to strategy π . $V(\pi)$ is a random function depending on the random number of steps in strategy π before the search process stops.

The total search cost assigned to any sequence π is a random function depending on the random number of steps in sequence π before the search process stops. We assume that the search process in the sequence π stops at the μ th step of sequence π , where μ is random which obtains the integer values $1, 2, 3, \dots$

If $\mu = N$, this means that within the first N steps the test detects that the target is a person $\pi[N] = i$ exactly H_i times, and then the search stops. Now we can formulate more precisely how the two-typed search process with two types of possibly erroneous outcomes differs from the search scenario of Matula [13], which had the errors of type-I only. Actually, the search under investigation can be looked at as a sequence of independent Bernoulli trials wherein a “single success” corresponds to the event that the test detects the target during a single inspection.

Denote by $P(\mu = N)$ the probability of H_i successes for person $\pi[N] = i$ occurring during N trials. It is known to have the negative binomial distribution (NBD) (for the corresponding NBD definition and notation, we refer the reader to standard texts, such as DeGroot [4]). Therefore, the probability that within the first N steps the test detects the target to be as person $\pi[N] = i$ exactly H_i times, is the following:

$$\begin{aligned} P(\mu = N) &= P(M(i, N, \pi)) \\ &= \binom{M(i, N-1, \pi)}{H_i - 1} (1 - f_i)^{M(i, N-1, \pi) + 1 - H_i} \cdot f_i^{H_i} \end{aligned}$$

Notice that we need to avoid a pathological case where the binomial coefficient $\binom{M(i, N-1, \pi)}{H_i - 1}$ is zero. For this aim, when formulating a set of feasible solutions, we add a simple technical detail, namely, we require that each sequence begins with the prefix $U_{\pi[0]}$.

For comparison, recall that in the case when the search model takes only the overlook probabilities into account, the detection of the target in the case if the target is the person i , follows a geometric distribution with parameter $1 - \alpha_i$. The probability of successful detection of the infected person in this case is much simpler:

$$P(\mu = N) = P(M(i, N, \pi)) = p_i \alpha_i^{M(i, N-1, \pi)} \cdot (1 - \alpha_i)$$

(see, e.g., [13, 5, 4, 7]), wherein it can be found by a single-stage algorithm.

In the presence of the errors of two types, the search problem becomes more complicated. However, we show that under certain sufficient conditions a greedy, two-stage algorithm can solve the problem.

Define the random cost $R(\mu, \pi)$ of the first μ steps of strategy π as follows:

$$R(\mu, \pi) = R(\pi[\mu], \mu, \pi) = c_{\pi[\mu]} \cdot T(\pi[\mu], \mu, \pi)$$

where $T(\pi[\mu], \mu, \pi)$ is the random search time before the searching process stops, which is computed as follows

$$T(\pi[\mu], \mu, \pi) = \sum_{j=1}^m t_j (H_j - 1) + \sum_{k=1}^{\mu} t_{\pi[k]}$$

In the above formula, the first term corresponds to the duration of the initial sub-sequence of steps $U_{\pi[0]}$ in sequence π where a preliminary information is gathered, while the second term is the duration of all subsequent steps of π . Notice that $T(\pi[\mu], \mu, \pi)$ is random since the μ is random.

Denote $T(\pi[N], N, \pi) = T(i, N, \pi)$ by T_i .

Then the expected cost of the target search in the sequence π is:

$$\begin{aligned} V(\pi) &= \text{Exp}(R(\mu, \pi)) = \text{Exp}(R(\pi[\mu], \mu, \pi)) \\ &= \sum_{N=1}^{\infty} (R(\pi[N], N, \pi)) P(\mu = N) \\ &= \sum_{N=1}^{\infty} (R(i, N, \pi)) \cdot P(\mu = N) \\ &= \sum_{N=1}^{\infty} c_i \cdot T_i \cdot P(\mu = N) = \end{aligned}$$

$$= \sum_{N=1}^{\infty} c_i \cdot T_i \cdot \binom{M(i, N-1, \pi)}{H_i-1} (1 - f_i)^{M(i, N-1, \pi)+1-H_i} \cdot f_i^{H_i}$$

Let us define the “fitness index” of each person as the following preference ratio Q_i :

$$Q_i = \frac{c_i \cdot P_i}{t_i} = \frac{c_i \cdot P_i(M(i, N-1, \pi))}{t_i} = \frac{c_i \cdot \binom{M(i, N-1, \pi)}{H_i-1} (1-f_i)^{M(i, N-1, \pi)+1-H_i} \cdot f_i^{H_i}}{t_i}.$$

The following two claims provide sufficient conditions for Q_i to be decreasing in M . Then, under these conditions, a greedy solution algorithm can be found.

Lemma 1. For any i , the ratio $Q_i = Q_i(M(i, N-1, \pi))$ is a decreasing function of $M(i, N-1, \pi)$ for $M(i, N-1, \pi) \geq H_i - 1$, if $H_i \cdot (1 - f_i) < 1 + f_i$.

The proof.

Denote $M(i, N-1, \pi) = k$. Then we have:

$$\begin{aligned} \frac{Q_i(k+1)}{Q_i(k)} &= \frac{c_i \cdot \binom{k+1}{H_i-1} (1-f_i)^{k+2-H_i} \cdot f_i^{H_i}}{c_i \cdot \binom{k}{H_i-1} (1-f_i)^{k+1-H_i} \cdot f_i^{H_i}} = \\ &= \frac{(k+1)!}{(H_i-1)!(k-H_i+2)!} \frac{(1-f_i)}{(k)!} = \frac{(k+1) \cdot (1-f_i)}{(k-H_i+2)} \end{aligned}$$

If $H_i \cdot (1 - f_i) < 1 + f_i$, we have:

$$\begin{aligned} H_i \cdot (1 - f_i) &< 1 + f_i, & H_i - 1 &< (H_i + 1) f_i \\ \frac{H_i - 1}{f_i} &< H_i + 1, & \frac{H_i - 1}{f_i} &< k + 2 \\ H_i - 1 &< (k + 2) \cdot f_i, & 1 - H_i &> -(k + 2) \cdot f_i \\ k - H_i + 2 &> k + 1 - (k + 2) \cdot f_i &> (k + 1)(1 - f_i) \\ \frac{(k+1)(1-f_i)}{k-H_i+2} &< 1 & \text{therefore} \\ \frac{Q_i(k+1)}{Q_i(k)} &= \frac{(k+1)(1-f_i)}{k-H_i+2} < 1 \Rightarrow Q_i(k+1) < Q_i(k) \end{aligned}$$

Lemma 1 is proved.

Lemma 2. For any i , the ratio $Q_i = Q_i(M(i, N-1, \pi))$ is a decreasing function of $M(i, N-1, \pi)$ when $M(i, N-1, \pi) > \frac{H_i-1}{f_i} - 1$.

The proof. Denote $M(i, N-1, \pi) = k$. As in Lemma 1, we obtain that $\frac{Q_i(k+1)}{Q_i(k)} = \frac{(k+1) \cdot (1-f_i)}{k-H_i+2}$.

According to the premise of Lemma 2, we have:

$$\begin{aligned} k &> \frac{H_i-1}{f_i} - 1 \\ k &> \frac{H_i-f_i-1}{f_i} \\ -kf_i &< f_i - H_i + 1 \\ k - kf_i &< k + f_i - H_i + 1 \\ k(1-f_i) + 1 - f_i &< k + f_i - H_i + 1 + 1 - f_i \\ (k+1)(1-f_i) &< k - H_i + 2 \\ \frac{(k+1) \cdot (1-f_i)}{k-H_i+2} &< 1 \\ \frac{Q_i(k+1)}{Q_i(k)} &< 1 \\ Q_i(k+1) &< Q_i(k) \end{aligned}$$

Lemma 2 is proved.

The next theorem permits to determine the optimal, i.e., min-time, sequence solving the problem.

Theorem 1. Assume that either $H_i \cdot (1 - f_i) < 1$, or $M(i, N-1, \pi) > \frac{H_i-1}{f_i} - 1$. The strategy π is optimal iff locations' preference ratios

$$Q_i = \frac{c_i \cdot P_i}{t_i} = \frac{c_i \cdot P_i(M(i, N, \pi))}{t_i} = \frac{c_i \cdot \binom{M(i, N-1, \pi)}{H_i-1} (1-f_i)^{M(i, N-1, \pi)+1-H_i} \cdot f_i^{H_i}}{t_i} \quad (3)$$

are arranged in decreasing order of magnitude.

Proof. Consider two adjacent strategies,

$$\pi_1 = U_{[s_1, 0]}, \pi_1[1], \pi_1[2], \dots, \pi_1[n], \pi_1[n+1], \dots$$

$$\pi_2 = U_{[s_2, 0]}, \pi_1[1], \pi_1[2], \dots, \pi_1[n+1], \pi_1[n] \dots$$

where the strategy π_2 is obtained from the strategy π_1 by transposing locations at the n th and $(n+1)$ th steps.

To prove the theorem, it is enough to prove the following statement:

$$V(\pi_1) < V(\pi_2) \Leftrightarrow Q_{\pi_1[n]} > Q_{\pi_1[n+1]}.$$

We have:

$$\begin{aligned}
V(\pi_1) &= \sum_{N=1}^{\infty} t_{\pi_1[N]} \cdot T_{\pi_1[N]} \cdot Q_{\pi_1[N]} = \\
&= \sum_{N=1}^{n-1} t_{\pi_1[N]} \cdot T_{\pi_1[N]} \cdot Q_{\pi_1[N]} + \sum_{N=1}^{n+2} t_{\pi_1[N]} \cdot T_{\pi_1[N]} \cdot Q_{\pi_1[N]} + t_{\pi_1[n]} \cdot T_{\pi_1[n]} \cdot Q_{\pi_1[n]} + t_{\pi_1[n+1]} \cdot T_{\pi_1[n+1]} \cdot Q_{\pi_1[n+1]} \\
V(\pi_2) &= \\
&= \sum_{N=1}^{n-1} t_{\pi_2[N]} \cdot T_{\pi_2[N]} \cdot Q_{\pi_2[N]} + \sum_{N=1}^{n+2} t_{\pi_2[N]} \cdot T_{\pi_2[N]} \cdot Q_{\pi_2[N]} + t_{\pi_2[n]} \cdot \left(T_{\pi_2[n]} - t_{\pi_2[n]} \right) \cdot Q_{\pi_2[n]} + t_{\pi_2[n]} \cdot T_{\pi_2[n]} \cdot Q_{\pi_2[n]} \\
V(\pi_1) - V(\pi_2) &= t_{\pi_1[n]} \cdot T_{\pi_1[n]} \cdot Q_{\pi_1[n]} + t_{\pi_1[n+1]} \cdot T_{\pi_1[n+1]} \cdot Q_{\pi_1[n+1]} - t_{\pi_2[n]} \cdot \left(T_{\pi_2[n]} - t_{\pi_2[n]} \right) \cdot Q_{\pi_2[n]} - t_{\pi_2[n]} \cdot T_{\pi_2[n]} \cdot Q_{\pi_2[n]} \\
V(\pi_1) - V(\pi_2) &= t_{\pi_1[n]} \cdot T_{\pi_1[n]} \cdot Q_{\pi_1[n]} + t_{\pi_1[n+1]} \cdot T_{\pi_1[n+1]} \cdot Q_{\pi_1[n+1]} - t_{\pi_2[n]} \cdot \left(T_{\pi_2[n]} - t_{\pi_2[n]} \right) \cdot Q_{\pi_2[n]} - t_{\pi_2[n]} \cdot T_{\pi_2[n]} \cdot Q_{\pi_2[n]} \\
V(\pi_1) < V(\pi_2) &\Leftrightarrow -t_{\pi_1[n]} \cdot T_{\pi_1[n+1]} \cdot \left(Q_{\pi_1[n]} - Q_{\pi_1[n+1]} \right) \Leftrightarrow Q_{\pi_1[n]} > Q_{\pi_1[n+1]}
\end{aligned}$$

The theorem is proved

The theorem claims that after some transient, AI-based, period, for which $M(i, N-1, \pi) > \frac{H_i-1}{f_i}-1$, for all

i , the searching strategy π is optimal iff at its each step $N=1,2,\dots$ the next person $\pi(N) = i^*$ is selected for which $Q_{i^*} = \max_j Q_j$, where the ratios Q_j are defined by Eq.(3) and the maximum operator is calculated at each step for an individual $j \in I$ with new value $P_j = P_j(M(j, N, \pi))$ re-calculated at each step N .

Notice that this theorem can be looked at as an extension of the Blackwell Theorem (Theorem 1 in [9]) for the case when the false-positive probabilities are non-zero.

Concluding this section, consider a numerical example illustrating the greedy procedure described in Theorem1.

Example. Let the search area contain three possible persons; the input data are presented in Table 1; $CL=0.95$.

Table 1. Input data

	Person 1	Person 2	Person 3
$p_i = P(C_i)$	0.1	0.15	0.75
$\beta_i = P(B_i \bar{C}_i)$	0.1	0.07	0.05
$\alpha_i = P(\bar{B}_i C_i)$	0.04	0.06	0.12
t_i (Min.)	5	8	10
c_i (\$)	100	10	1

Applying the obtained formulas for probabilities f_i , heights H_i , and ratios Q_i , we find that $f_1=0.126$; $f_2=0.191$; $f_3=0.743$; $H_1=H_2=2$; $H_3=1$, and $U_{s0} = \langle 1, 2 \rangle$. At the next step, referred to as Step 3, we obtain: $Q_{\max} = Q_1 = 15.277$, $s(3)=1$. Then we obtain that at Step 4, $Q_{\max} = Q_1 = 3.249$, that is, $s(4)=1$; at Step 5, $Q_{\max} = Q_2 = 0.819$, $s(5)=2$. Thus, the best

search sequence found up to Step 5 is the following: $\pi^{opt} = \{1, 2, 1, 1, 2\}$; its time function is $F(\pi^{opt}) = 2,020.80$. If we take, for comparison, a random search sequence, for instance, $s^{random} = \{1, 2, 1, 2, 1, \dots\}$, we obtain a worse time value: $F(s^{random}) = 2,142.04$. Continuing the calculations, we obtain that at Step 20 $F(\pi^{opt})=3,524.60$ and $F(s^{random})=4,236.02$. After this step, the further changes in the time function values become negligible.

Discussion. It is worth noticing that the suggested greedy algorithm, which guarantees that the probability of correct target detection is no less than a pre-determined confidence level CL , outperforms in practice well-known search algorithms. For instance, the Matula algorithm [9] stops as soon as the “first success” occurs, that is, the tests discover, for the first time, that a patient i is infected. As another example consider the Alidaee algorithm [1] for the so-called ‘repeated search’, wherein the searching process continues until the tests claim twice that a certain person is infected. For reader’s convenience, we present below the formula for the successful detection given by the Alidaee algorithm [1].

As follows from Proposition 2, the probability of successful detection of the target by the Alidaee algorithm [1] (i.e., in the case when the discovery of the target is to be repeated twice) is the following:

$$\frac{p_1(1-\alpha_1)^2}{p_1(1-\alpha_1)^2 + (1-p_1)\beta_1^2}.$$

We can see that the probability of correct detection provided by the suggested algorithm is considerably higher than the corresponding probabilities in two other algorithms.

IV. CONCLUDING REMARKS

For the sake of completeness, among many interesting properties of the considered search problem with two types of errors, let us consider how changes the frequency of search of a particular location in an optimal sequence in the case of the errors of two types. In fact, this frequency turns out to be somewhat similar to the corresponding frequency in the case of the type-I errors as in Matula [9], but the essential difference is that the probabilities α_i should be substituted by $(1-f_i)$, as the following claim states:

Let π be an optimal testing sequence, Then

$$\lim_{N \rightarrow \infty} \frac{M(i, N, \pi)}{N} = \frac{\frac{1}{\log(1-f_i)}}{\sum_{j=1}^N \frac{1}{\log(1-f_j)}}.$$

The proof of this fact is along the same lines as that of Matula [9], so we skip it.

A popular goal that has been studied in the literature is to maximize the probability of correct finding the target within a fixed number of tests (see Kadane [5] and Kress et al. [6], among others). It would be interesting to find such a probability for a more general diagnosis problem with two types of the test errors. Another attractive direction for future research is to study the properties of the search problem for stable or moving clusters of people with two types of the false test outcomes.

References

- [1] B. Alidaee, Optimal ordering policy of a sequencing model, *J. Opt. Theory and Appl.*, 83(1) (1994) 199-205
- [2] S. Alpern, R. Fokkink, L. Gasieniec, R. Lindelauf, V.S. Subrahmanian (Eds.), *Search Theory*, Springer, 2013.
- [3] M. Atkinson, M. Kress, R.-J. Lange, When is information sufficient for action? Search with unreliable yet informative intelligence, *Oper. Res.* 64(2) (2016) 1-14.
- [4] M.H. DeGroot, *Optimal Statistical Decisions*. John Wiley & Sons, 1986.
- [5] J.B. Kadane, Optimal discrete search with technological choice, *Math. Methods Oper. Res.* 81 (3) (2015) 317–336.
- [6] M. Kress, K.Y. Lin, R. Szechtman, Optimal discrete search with imperfect specificity, *Math. Meth. Oper. Res.* 68 (3) (2008) 539–549.
- [7] B. Kriheli. E. Levner, A. Spivak, Optimal search for hidden targets by unmanned aerial vehicles under imperfect inspections, *Amer. J. Oper. Res.*, 6 (2016) 153-166
- [8] E. Levner, Infinite-horizon scheduling algorithms for optimal search for hidden objects. *Int. Trans. Oper. Res.* 1 (1994) 241-250.
- [9] D. Matula, A periodic optimal search, *Amer. Math. Monthly* 71 (1) (1964) 15–21.
- [10] J. Pei, X. Liu, W. Fan, S. Yang. Single machine serial-batching scheduling with independent setup time and deteriorating job processing times, *Optim Letters*, 9(1) (2015) 91–104
- [11] D. Roberts, J. Gittins, The search for an intelligent evader: Strategies for searcher and evader in the two-region problem, *Naval Res. Logist. Q.* 25 (1) (1978) 95–106.
- [12] S.M. Ross, A problem in optimal search and stop, *Oper. Res.* 17 (6) 1
- [13] P.N. Valenstein, Evaluating Diagnostic Tests with Imperfect Standards, *American Journal of Clinical Pathology*, Vol. 93, Issue 2, 1 February 1990, Pages 252–258, <https://doi.org/10.1093/ajcp/93.2.252>
- [14] A.R. Washburn, *Search and Detection*, INFORMS, 2002.
- [15] WHO -World Health Organization, Use of influenza rapid diagnostic tests, (2010) pp. 1-27.

Using PDSA Methodology to Develop a New Flexible Tool for Handover

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Abstract

Background: Handover, the process of transferring medical information among professionals and between shifts is crucial for maintaining continuity of care and safety, especially for complex patients. **Objective:** The aim of this study is to develop a process that would meet the needs of clinical staff for efficient shift handovers.

Methods: The PDSA model was used to prospectively develop, implement, evaluate and reassess a new handover tool in a 900-bed teaching hospital in central Israel. Questionnaires to determine the most critical information needed for handover were sent throughout the hospital. Nursing and medical staff of 35 departments participated. Medical staff participated in developing the new handover tool according to their needs, and in its implementation. Management had a leading role in introducing the tool.

Results: With 63.7% response rate, 13 key items were classified into 4 categories: 1) Patient identification, 2) Focused clinical data 3) Use of supportive devices, and 4) Patient's socio-cultural background. Consequently, a Flexible hAndover Structured Tool (FAST) to transmit core information was developed for all hospital departments, with a flexible feature of adding specific information required by some departments. A major component was transmitting information regarding complex patients in writing and verbally for other patients.

In the first quarter, compliance with the FAST method was 62%-99% in various departments. Revisions based on hands-on experience, led to high satisfaction with the new tool in most hospital departments. It was adopted easily during the COVID-19 pandemic.

Conclusions: Developing a new handover process—FAST was challenging, but rewarding. Its use increased awareness and improved reporting by all professional teams in daily practice. Using PDSA methodology, enabled continuous monitoring, oversight, and adaptive corrections for better implementation of this new handover reporting tool.

Keywords— Handoff, hospital change, patient safety, PDSA, quality improvement.

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Clinical Application of Versatile Pedicled Perforator Flap in Breast Reconstruction

Neerja Gupta

Abstract— Background: The evolution of perforator flaps has revolutionized the oncoplastic techniques in breast conservation especially in large resections. While free perforator flaps have been extensively studied after the introduction of 'reconstructive elevator' concept; pedicled perforator flaps are still in the era of evolution. Based on the learnings from free perforator flaps in terms of preoperative imaging, Taylor principles of angiosomes, Saint Cyr, et al and many others working on cadavers to identify anatomy and topography of perforators, and the principles of direct channels and sequential fillings in perforasomes, there is enough light on the distribution of perforators in chest wall. This has helped in their accurate topographic mapping and application. Methodology- All eight patients who underwent partial reconstruction of breast with pedicled perforator flaps were retrospectively analyzed. Selections of the flap was done based on the location of tumor, anticipated volume loss, willingness to undergo contralateral symmetrization, cosmetic expectations and finances available. Four patients underwent LTAP (lateral thoracic artery perforator), 4 being vertical and one oriented horizontal. The distal limit for design of the flap was the inframammary crease the distal limit of its angiosomal territory. 3 patients underwent MICAP flap (medial intercostal artery perforator), anterior axillary line as distal point. Preoperative mapping was done using hand held doppler only. Flap harvest time was 20-25 minutes. Intra operative vascularity was assessed with dermal bleed and Doppler reassessment at the skin paddles after the flap was harvested but before in setting. The patient immediate pre-, post-operative and follow-up pics were compared independently by two breast surgeons. Patients were given breast Q questionnaire (licensed) for scoring. Results-The median age of eight patients was 50. Each patient had a hospital stay of 24 hours. The specimen dimensions were from 8x6.8x4 cm (smallest) to 19x16x9 cm (largest). The breast volume reconstructed range was 20 percent to 45 percent. All wide excision had free margins on frozen. The mean flap dimensions that was harvested was 12x5x4.5 cm. Drain were inserted in all but one of LTAP and none in MICAP. One LTAP underwent marginal necrosis, venous congestion and delayed wound healing. Three patients out of eight were phyllodes of which one was borderline and 2 were benign on final histopathology. 5 patients were invasive ductal cancer. All have completed their radiation. The median follow up is 6 months. The satisfaction scores at median follow of 10 months are 95 for physical wellbeing and 85 for surgical results. Surgeons scored fair to good in Harvard score. Conclusion- Pedicled perforator flaps are a valuable option for regional reconstruction requiring 3/8th volume replacement of breast defects. While MICAP is preferred for inner, central and lower quadrant, LTAP is a versatile flap for any quadrant. The vascularity of the flap is dependent on the angiosomal territories; adequate blood flow which can be confirmed on hand held doppler only in pre-operative setting and intraoperatively.

Keywords— breast reconstruction, lateral thoracic artery perforator, intercostal artery perforator, pedicled perforator flap.

Defining Anatomical Territories of Chest Wall in Pedicled Perforator Flap Reconstruction of Breast

Neerja Gupta

Abstract— Background- After the learnings from Sir Michel Saint Cyr, Sir Ian Taylor, it was clear that the direct and indirect vessels between two perforasomes territories form the basis of harvest of a viable flap. However, the exact boundaries are unknown while designing the chest wall perforator flaps. Since the diameter of Perforator is directly linked to the blood flow and this corroborates closely with the velocity and Doppler intensity, the flow is easily measured on hand-held doppler. However, the flap extent from the point of maximal intensity is not specified in any of the studies the author reviewed till date. Reviewing the anatomy of anterior Intercostal (AI) which anastomoses with posterior Intercostal at level of anterior axillary line, there are two perforators arising from anterior Intercostal artery; one arising at 1.5-2cm, another at 5-7 cm from the midline. The first one forms the basis of MICAP and the AICAP respectively. These two are nearly constant with a good diameter of around 1 mm. The donor flap thickness can be a single Intercostal space and length extending not beyond the anterior axillary line. AI is absent below 9th space, a perforator from the superior epigastric can be utilized. Neither CT angiography nor ICG is needed; only doppler is sufficient for viability of flap. The lateral thoracic artery-based perforator (LTAP) is identified at the junction of lateral breast fold and midaxillary line at the level of nipple. The perforator is absent in four out of 30 cases where a perforator from L.D was identified, in cadaveric studies, 2 cm from the breast fold a more constant one. The LTAP perforator has a nearly constant diameter of 1.45 ± 0.5 mm. Flaps can be raised with a radius of 5-6 cm, length-breadth ratio of 2:1, distal limit being the infra mammary crease. Doppler helps assuring the viability during inseting and is the most reliable tool for harvest. Methodology- All the eight patients who underwent pedicled chest wall perforator flaps for breast reconstruction were analyzed from prospectively collected data. The informed and signed consent forms for the study were retrieved. Patients were assessed for clinical, surgical and QOL parameters. Breast Q BCT module and Harvard scoring were used for interpretation. Results- The median age of eight patients was 50. Each patient had a post-operative stay of 24 hours. The specimen dimensions were from 8x6.8x4 cm (smallest) to 19x16x9 cm (largest). The percentage breast volume replacement required was 20 percent to 45 percent. All wide excision had free margins on frozen. The mean flap dimensions harvested was 12x5x4.5 cm. Out of eight, five were LTAP, three were MICAP. One of the five LTAP patients underwent partial flap necrosis. All other flaps had minor uneventful recovery. On final histopathology, 3 were phyllodes, two benign, one borderline. Mean duration of flap harvest was 20 minutes. All IDC have completed their radiation and mean follow up is 12 months. Patient mean Breast Q scores for satisfaction with breasts was 80. Harvard cosmetic scoring was fair to good by surgeons.

Keywords— anterior intercostal artery perforator, breast reconstruction, lateral thoracic artery perforator, middle intercostal artery perforator.

Complications Associated with Pre-pectoral Immediate Breast Implant or Expander Reconstruction Using Acellular Dermal Matrix Meshes

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Abstract— In the past decade, most of the immediate breast reconstruction is pre-pectoral using acellular dermal matrix (ADM). The basic aim of this audit is to assess outcome data on complications using acellular dermal matrix in pre-pectoral implant or expander-based immediate breast reconstruction. After receiving institutional review board approval, a prospective study was undertaken. 14 patients with 16 numbers of procedures initiating from August 2019 were reviewed. We evaluated patient demographics, surgical techniques, and complications. Complications were evaluated for infection, seroma, necrosis of flap requiring additional surgery. Association of Breast Surgery and British Association of Plastic, Reconstructive and Aesthetic Surgeons guidelines. Average age was 56 years. Most of the patients had skin sparing mastectomy for cancer including both invasive and pre invasive disease. One patient had post operative infection with positive pus culture and raised inflammatory markers and got readmitted for intravenous antibiotics treatment and needed wash out. Six patients had to be taken back to theatre, one for wash out, one for loss of ADM and four for debridement of necrotic skin or nipple areolar complex respectively. No patient had implant loss up to 90 day of follow up. Overall infection rates in our study was 6.25%. We should follow the guidelines given by Association of Breast Surgery and British Association of Plastic, Reconstructive and Aesthetic Surgeons for immediate breast reconstruction.

Keywords— acellular dermal matrix, immediate breast reconstruction, infection, pre-pectoral space.

A New Wearable Transcutaneous Electrical Nerve Stimulation Device (Actitens®) is More Efficient and Better Tolerated Than Weak Opioids in the Treatment of Knee Osteoarthritis Pain

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Objectives

Knee osteoarthritis (KOA) is a frequent disease for which therapeutic possibilities are limited. In current recommendations, the first-line analgesic is acetaminophen. However, its low efficacy frequently leads to the use of weak opioids (WO) despite their poor tolerance, especially in elderly patients.

The primary objective was to compare the analgesic efficacy and safety of a new wearable transcutaneous electrical nerve stimulation (W-TENS) to weak opioids (WO) in the treatment of moderate to severe, nociceptive, chronic pain in KOA patients.

Material and Methods

ArthroTENS study is a non-inferiority, multicentric, prospective, randomized, single-blinded for primary efficacy outcome, controlled, 2-parallel groups, clinical study. It compared W-TENS to WO over a 3-month controlled period with an additional optional non-controlled 3-month follow-up in W-TENS group.

Patients had KOA (ACR criteria) with baseline pain intensity (PI) ≥ 4 on a numerical rating scale (NRS), after failure to level 1 analgesics/NSAIDs, a Kellgren-Lawrence grade ≥ 2 and were assessed at baseline, M1 and M3.

The co-primary outcomes were PI at 3-month and the number of treatment-related adverse events (TRAEs) over 3 months. Secondary outcomes included WOMAC function, EuroQol, responder rates defined by PI reduction ≥ 30 and $\geq 50\%$ and OMERACT-OARSI response criteria. The non-inferiority margin was defined as 0.825 on PI reduction.

In W-TENS group, an advanced, mobile app enabled, wearable TENS was used. 100Hz and 2 Hz frequency stimulations were delivered via electrodes with standardized positioning (Figure 1).

Results

The non-inferiority of W-TENS was demonstrated in both the PP and ITT populations (Table 1). At M3, PI in PP population was 3.87 (2.12) compared to 4.66 (2.37) (delta: -0.79 (0.44); 95% CI (-1.65; 0.08)) in W-TENS and WO groups, respectively. Since the absolute value of the 95% CI of the between-treatments mean PI difference [-1.71, -0.12] was above 0 in ITT set, the planned superiority analysis was performed, demonstrating that W-TENS was significantly superior to WO at M3 ($P=0.0124$).

In the ITT population, the number of potentially TRAEs was significantly lower ($p<0.001$) in the W-TENS group ($n=7$) than in the WO group ($n=36$) during the 3-month controlled follow-up. The AEs observed in the W-TENS group were mainly local cutaneous reactions (erythema: 5.5%) due to the TENS technique, while those observed in the WO group were systemic and well known (dry mouth: 1.8%; vomiting: 1.8%; pruritus: 3.6%; dizziness: 5.5%; drowsiness: 7.3%; nausea: 10.9% and constipation: 12.7%) and limit their use and effectiveness in clinical practice. Thirty-nine (70.9%) patients wished to extend W-TENS treatment for 3 additional months. The efficacy was maintained throughout this additional therapeutic period. All secondary outcomes favored the W-TENS group at M1 and M3.

Conclusion

W-TENS was more effective and better tolerated than WO in the treatment of nociceptive KOA chronic pain and could represent an interesting non-pharmacological analgesic alternative for patients.

Figure 1: Standardized positioning of W-TENS electrodes.



Table 1: Non-inferiority analyses on PI at M3. PP and ITT populations

Measure population	W-TENS	WO	W-TENS - WO	
PP population				
n	52	47		Non
Mean (SD)	3.87 (2.12)	4.65 (2.37)	-0.79 (0.44)	inferiority
95% CI	[3.28, 4.46]	[3.96, 5.35]	[-1.65, 0.08]	demonstrated
				95% CI < 0.825
ITT population				
n	55	55		Non
Mean (SD)	3.84 (2.08)	4.73 (2.28)	-0.92 (0.40)	inferiority
95% CI	[3.27, 4.40]	[4.11, 5.35]	[-1.71, -0.12]	demonstrated
				95% CI < 0.825

In Vitro Antioxidant and Free Radical Scavenging Activity of *Phyllanthus Emblica* L. Extract

Benyapa Suksuwan

Abstract— Introduction: Oxidative stress is identified as the root cause of the development and progression of several diseases as the disproportion of free radicals in the body leads to tissue or cell damage. Polyphenols are the most common antioxidant found in plants and are efficient in capturing oxidative free radicals. Aim of the Study: This study focused on the antioxidant activity of polyphenols extracted from *Phyllanthus Emblica* L. as oxidative stress plays a vital role in developing and progressing many diseases, including cardiovascular diseases and cancer. Materials and Methods: The plant was extracted using a mixture solvent (ethyl alcohol: water in ratio 8:2). The total phenolic content of *P. Emblica* extract was determined using the Folin-Ciocalteu method and calculated as gallic acid equivalents (GAE) and various antioxidant assays DPPH and ABTS radical scavenging capacity assays. Results and Discussion: The findings exhibited a strong correlation between antioxidant activity and the total phenol contents. In addition, the IC_{50} of *P. Emblica* extract via DPPH and ABTS assays were $68.10 \mu\text{g/mL} \pm 0.455$, and $49.24 \mu\text{g/mL} \pm 0.716$, respectively. Furthermore, *P. Emblica* extract showed antioxidant activities in a concentration-dependent manner. Vitamin C was used as a positive control in the DPPH assay, while Trolox was used as a positive control in the ABTS assay. Conclusions: In conclusion, *P. Emblica* extract consisted of a high amount of total phenolic content, which possesses potent antioxidant activity. However, further antioxidant activity assays using human cell lines such as SOD, ROS, and RNS scavenging assays and in vitro antioxidant experiments should be performed in order.

Keywords— antioxidant, ABTS scavenging, DPPH scavenging assay, total phenol contents assay, *Phyllanthus Emblica* L.