



BITRI NEWSLETTER

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TECHNOLOGY SOLUTIONS

FROM YOU
TO US
FOR YOU

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MISSION

To conduct needs-based technology research that provides sustainable innovative solutions through co-creation and collaboration with local and international stakeholders.

VISION

To be the leading technology solutions provider that transforms lives.

EDITORIAL

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Teamwork

We operate and innovate through teamwork, and although we expect individual expertise, the team performance takes priority. The value of innovation through teamwork includes behaviour such as valuing contribution, accepting diversity, pro-active approach, collaboration and co-creation.



Excellence

We expect and encourage unquestionable technical and operational excellence in planning, executing, monitoring and continuously improving everything we do.



Empathy

We interact, operate and generate solutions that optimally balance the interest of all stakeholders

Botswana Institute for Technology Research and Innovation (BITRI)

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CEO's Foreword

September 2020



It is with great pleasure that we present the BITRI third quarter external newsletter of the year 2020. It would be remiss not to mention that this passage of time has been challenging and turbulent at times for all across the globe, in specific countries and localized communities. The world is now well into its ninth month of the COVID-19 pandemic, bringing with it unprecedented economic declines, failure of some big as well as small business enterprises, loss of jobs and livelihoods, loss of lives, as well as an ominous dark cloud of uncertainty.

Since the establishment of BITRI some six years ago, the institution was established with the Mandate of identifying, developing and/or adapting technology solutions that provide sustainable innovative solutions through co-creation and collaboration in line with national priorities and needs of Botswana. Research and Development (R&D) by its nature, is not a linear process, and in our endeavor, we have been ambitious and bold in pursuit of accomplishing various projects and research outcomes.

This edition of the newsletter will concern itself with sensitizing you as our important stakeholder, of the various projects that are ready for consumption, and invite you to make inquiries and purchases of technology solutions that are of interest to you and your organisations and businesses. In giving you a glimpse, I will state some of the key projects and invite you to engage with the publication to learn more about our innovations.

The Nanofiber Membrane (Version 2), developed by the Nanomaterials division has displayed some versatility in application

air-filtration and can be used in many industries like health care, energy and defense and security. The rollout of the BOBS-certified KSBB Technology is gaining momentum, and with it, Botswana will get to use an eco-friendly, sustainable, durable and affordable masonry product for constructing their business and residential properties.

On the aspect of our laboratory services, the Centre for Material Science invites you to utilize its services that include water and mineral analysis, analysis of heavy metals in water, elemental analyses of synthesized materials and geological material, mineral analysis of geological material, elemental analyses as well as oil or lubricants testing. The BITRI Design studio serves to bring the technological solutions to live through the products and services which impact on people's lives, and we invite you to bring consult us on aspects of design consultancy and realization of envisioned projects.

The Nthusa emergency response management system will add value by providing time-critical services to customers, and the Seding® solar light, which is now offered in

the V2.5 edition, has been installed in various locales and has performed well in providing safety in public parks, communal spaces, and highways.

We sincerely desire that these, and our other technology solutions along the pipeline, will provide sustainable innovative solutions to you and transform your lives, as captured by our Mission Statement and Vision. I, therefore, invite you to engage this newsletter and start a conversation that will help us serve you better.

On behalf of the BITRI the Board of Directors, Management and team, I would like to express gratitude for your continued support. Our team wishes you fortitude, prudence and judiciousness in navigating through the uncharted terrain that COVID-19 has thrust upon all facets of our existence.

Prof. Shedden Masupe

PhD, SMIEEE, Pr.Eng
Chief Executive Officer



The Endless Possibilities of Design @BITRI



With BITRI having been established with a mammoth responsibility of identifying, developing and/or adapting appropriate technology that provide sustainable innovative solutions, it goes without saying that the institution had to have the internal capacity to translate the outputs of research and development into products that end users can readily use.

The results of applied research achieved through BITRI internal expertise, as well as in collaboration with partners, has to not just enable the institution to achieve its business goals, but has to be relevant, human-centred, cutting-edge and sustainable in the same breath.

Enter the Design division, the creative and solutions realization hub of BITRI that works within the BITRI mandate to bring the technological solutions to live through the products and services which impact on people's lives. The division serves to steer the institute's user-centric technology-based research and development through an active and continuous engagement of the relevant stakeholders in the product development processes, ensuring appropriate solutions plus the essential buy-in by the users of the technologies developed.

The five-member BITRI Design team, each with variegated expertise in creativity and innovation, industrial and product design processes, materials, and techniques work to amongst others dispensed adopt, adapt and develop affordable and appropriate design solutions to meet needs of the customers, develop customized products and to improve on their service delivery, provide expert advice and consultations to specific needs in areas of consumer products and services, as well as to provide technical expertise and design value addition to incubation hubs, manufacturing facilities and production plants.

The Design division comprises of three (3) units, these being the Additive Manufacturing (AM) Prototyping Centre, the Design Studio/ Consultancy section, as well as the the Product Design & Development section.

ADDITIVE MANUFACTURING PROTOTYPING CENTRE

BITRI currently has two Additive Manufacturing (3D printing) machines of different printing techniques, these being Fused Deposition Modelling (FDM), a technology where the melt extrusion method is used to deposit filaments of thermal plastics according to a specific pattern and Selective Laser Sintering (SLS). The method uses laser as the power source to sinter powdered material, aiming the laser beam automatically at points in space defined by a 3D model, binding the material together to create a solid structure.

We shall provide an overview of the capabilities of these machines, and what benefit they would bear for you as an innovator.

THE ZORTRAX M200 PRINTER (FDM)

The M200 uses FDM. It has a heated print bed and a small control screen. This is currently the leading desktop 3D printer for working with ABS (Acrylonitrile butadiene styrene, a robust thermoplastic polymer) filaments and a range of thermoplastic materials made by Zortrax (proprietary filament). The maximum build size for the models the Zortrax M200 printer can build is 200mm x 200mm x 180mm (height).

The M200 enables you to prototype consumer products at relatively lower costs, offers automated and precise architecture modelling, allows for low cost 3D printed educational props, as well as on the spot 3D printing of spare parts for large scale manufacturing setups.

The M200 also is capable of 3D printing of models in facial reconstruction and planning of surgeries based on CT scans, building prototype tools for astronauts, building robots, as well as modeling in clay in the early stage of automotive research and development.

The Zortrax M200



THE EOS FORMIGA P 110 (SLS)

The Formiga P110 is a flexible, cost-efficient and highly productive system for the Additive Manufacturing of polymer parts, small series production, customized products with any complex geometries. Without requiring tools, the system makes direct use of digital CAD data to produce polymer parts of the highest surface quality to a maximum construction height of 330 mm.

The Formiga P110 offers benefits that include sustainability as it uses materials with a high level of recyclability, low energy consumption that reduces operational costs and promotes preservation of the environment. It is also highly efficiency as it has shortened cycle, minimum downtimes due to the streaming concept which allows for the P110 to start building the job as soon as the job file is loaded and offers optimum usage of space thanks to an improved thermal management system.

In addition, the P110 offers unparalleled user-friendliness as it is convenient to handle through a high degree of automation and intuitive user interfaces. Moreover, the P110 delivers on the aspect of flexibility due to easy integration into existing production environments, its capacity to use a wide range of materials (including PA 2200, PA 2201, PA 3200 GF, PrimeCast 101, PA 2105 and various other materials in planning). The Formiga P110 has an accurate layer thickness with ranges of 0.06mm, 0.10mm, 0.12mm, combined with F-theta lens high speed scanner. 6

PRODUCT DESIGN & DEVELOPMENT

The Design & Development studio develops different projects from low-end technology projects to complex products, and closely works with all the BITRI research departments to transform their research outputs into tangible products and services, addressing the different societal needs.

The Design division works to coordinate activities of various stakeholders to enable the BITRI to create the conditions necessary for delivery of cost-effective and applicable solutions. The stakeholders are engaged in co-creation activities in design, development, and commissioning of consumer and industrial products and services, as well as marketing communications to reach out to the end users.

DESIGN ADVISORY/ CONSULTANCY

The division also offers design advisory services to the industry, enabling an improved national design awareness and manufacturing capacity. Through this, the division has the ability to change the direction of the country from a diamond dependent economy to an industrialised and innovative one.

The division also runs Design Thinking training and facilitation, to foster creativity, innovation, and user-centricity, assisting BITRI to come up with actionable solutions which are desirable for the user, viable for business and technologically feasible.



The COVID-19 Pandemic Challenges:

Interventions from the BITRI Design Perspective



3D Printed Ventilator Splitters

With the advent of COVID-19 pandemic, we were presented an opportunity to design products which could alleviate the effect of the pandemic. Besides requests to BITRI from government departments, we also received requests from industry (especially those whom we had already contacted for planned visits) for possible solutions against the COVID-19 situation.

The BITRI AM Response

We visited the Sir Ketumile Masire Teaching Hospital at the University of Botswana, to understand the typical Covid 19 patient related needs and context. We also held in- depth discussions with some of the industries to establish the contexts of their needs, as well as possible levels of collaboration. In collaboration with our stakeholders, we developed health-based products against the COVID-19 pandemic.

The BITRI AM Response Products

3D Printed Ventilator Splitters

As the pandemic grows, the number of patients needing breathing assistance through ventilators will also increase, and the country has a limited supply of these (only 130 nationwide). BITRI is working with the local teaching hospital, having conducted mechanical and physiological tests, and currently working on the medical validations.

3D Printed Mask

The Design division printed a nylon-based (PA 2200) breather mask, which uses the BITRI developed nanofiber membrane to filter the air. The membrane is a small breathable consumable piece, replaceable after a 24 - 48 hours use (depending on the environment). The rest of the mask is washable with soap and water, can be sanitized for repeated use.

The benefit for such an innovation is such it results in a highly-effective masks owing the BITRI-produced membrane's high Viral Filtration Efficiency (VFE), produces less waste due to reusability of the larger component in it, therefore adding an eco-friendliness advantage in comparison to competitor products and substitute products.

The 3D Printed Face Shields (Visors)

Using the same nylon-based plastic, the face shields are printed in two separated strips that are joined (without any adhesive) to build a frame that holds a clear laser-cut shield. The shield is held at the back with an elastic strap. Thus far, the face shields have been issued for use by BITRI restaurant staff, BITRI reception staff, as well as security staff stationed in all of the four BITRI campuses in Gaborone, Palapye and Kanye.

Various other 3D Printed Components

The division also used the same nylon-based plastic to assist in building various other components intended at completing other assistive devices (with complex geometry, to be fabricated with conventional processes) to fight against the COVID-19 pandemic. Among those include, fixing components for the hand wash station, and in the automation of the mechanical ventilator.



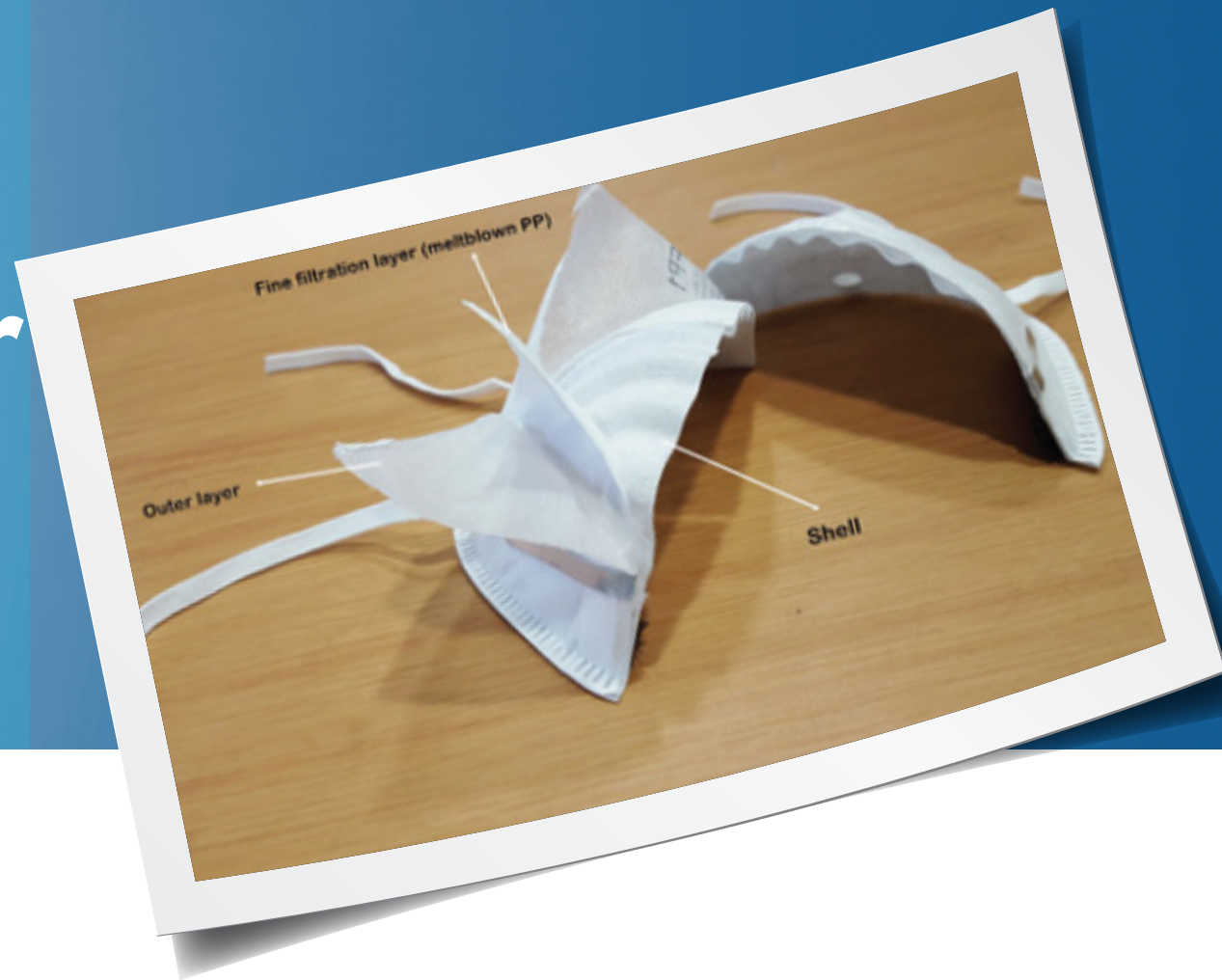
The Nanofiber Membrane (Version 2)

– A Potential Game Changer for Medical Masks and PPE Manufacturers

The Nanofiber Membrane (Version 2), developed by the Nanomaterials division, is non-woven electro-spun nanofiber membrane made of a versatile polymer with good contaminant blocking capacity at sub-micron level or it can sieve some very small particles including unwanted bacteria and micro particles. This air filter material is a critical component or key feature in the respiratory mask industry (especially in 3 layered masks).

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Products Features and Benefits

HIGH BREATHABILITY

The BITRI-manufactured membrane improves breathability by 30 to 40% in comparison to similar solutions. Dust and clinical masks made from the membrane can be worn over extended periods of time with little discomfort to the user, thereby, protecting the user.

VERSATILITY

The filtration membrane accommodates in 3 different classes of Filtering Facepiece (FFP) Masks (FFP 1 to FFP 3). FFP 1 can block at least 80% particles as small as 0.6 micron. FFP 2 means the membrane can filter out at least 94% the same size of particles, and the top range, being the FFP 3 category, translates to the membrane being able to filter out 99% of particles, and this range includes radioactive and poisonous particles.

The technology can be adopted in other products beyond those in air-filtration and industrially applicable in many industries like health care, energy and defense and security.

SUPERIOR PERFORMANCE

The membrane developed by BITRI have a Viral Filtration Efficiency (VFE) of >99.9%. These results mean that the material used to make the

membranes can be used to manufacture health /medical masks for medical practitioners and areas of outbreak of epidemics like bird flu and Ebola. BITRI also, has plans to test the masks in some mines in Botswana.

LIGHT WEIGHT MATERIAL

The nanofiber membrane layer used in the masks has a weight of about 0.3 g/m².

PRODUCT QUALITY

Tests results of the fiber has been used in Greenline Product face masks. The results revealed that they conform to South African Bureau of Standards (SABS) of SANS 50149:2003.

TARGET MARKET

With this innovative product, BITRI is targeting dust mask producers, medical masks producers, the defence and security functions, as well as mines.

The institution is also exploring the possibility of pitching the product to enterprises in the air filter manufacturers as they would derive greater applicability of the material in serving their customers across different demographics and markets.



The Nthusa Emergency Response Management System – A Helping Hand in Emergency Situations

Nthusa Emergency Response Management System is a mobile-enabled integrated suite of applications that help agencies that provide time-critical services to work more effectively and deliver service in a timely manner. This product was developed by ICT Associates programme under the Information Systems & Technology division and has been licensed exclusively to a company formed by graduates of the ICT Associates programme.

Nthusa system is made up of three applications, namely the Nthusa Public App, **Nthusa Agency Dashboard** and **Nthusa Responder**.

The Nthusa Suite of Applications

- **Nthusa Public App** – this is a mobile app (currently available for Android devices only) that is freely available to the public. When someone is in a distress situation, they can use the app to quickly send a message to the Agency Dashboard at the police, ambulance services or the fire department. The sender's geolocation is automatically embedded in the message which helps the responders to locate them in a timely manner.
- **Nthusa Agency Dashboard** – this is the command center of the system. Messages sent from the Nthusa Public App are displayed through the dashboard and agency staff (e.g. the police) can send responses to the sender. The dashboard also has a map feature which displays the location of the distressed person as well as real-time location of resources in the field, such as ambulances, police vehicles or officers patrolling on foot or bicycles. This information is then used to dispatch responders to the reported incident by forwarding the message to their Nthusa Responder.
- **Nthusa Responder** – this is a mobile app that is used in the field (e.g. by paramedics or patrolling officers). The app includes navigation capability to assist responders to quickly locate the person in distress using the geolocation information sent from the Nthusa Public App.

What Benefits Does *Nthusa* Offer to You?

The public app, though currently available for Android OS users only, is free charge to the public. The other positive attribute of the solution is that it pinpoints the exact location of the person in distress, thereby, enabling timely delivery of the required services that may include rescue in fire situations, health-related emergency situations such as when the user is experiencing warning signs of a heart attack, and when the user's safety is being compromised. Due to accuracy in pinpointing user's location, the system circumvents challenges such as language barriers and those related to user's capability to provide accurate location descriptions, and when it would further comprise the user's safety if they were seen to be involved in some form of communication.

A benefit for member of public in distress and the institution providing the required services, is that *Nthusa* allows for continuous communication with the user to relay vital information or update them on the status of the response to reassure them. In addition, the system enables for provision of updates after the event, such as in instances in which a case for the incident was opened.

From the perspective of institutional users such as ER service providers and law enforcement agencies such as the Police and other agencies that provide critical time-sensitive services such as the

NTHUSA

EMERGENCY MANAGEMENT RESPONSE SYSTEM

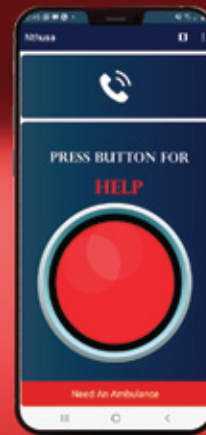
PRESS, DIAL & GET IMMEDIATE RESPONSE

MEDICAL

FIRE

CRIME

ROADSIDE



CITIZENS APP • COMPUTER AIDED DISPATCH • RESPONDENTS APP

Fire Department, the capability of the system to capture and store data enables the users to enhance operational intelligence as well as improve on aspects of their operations that pose a constant challenge. The system also enables resource rationalization, including vehicles and staff as it enables agencies to communicate with each other on the optimal deployment of their resources in a complementary manner.

The target market for *Nthusa* comprise principally of EmergencyRescue service providers, law enforcement agencies such as the Police and other agencies that provide critical time-sensitive services such as the Fire Department, as well as the general public.

The KSBB- Eco-friendly, Economic and Strong on Aesthetics



The Kalahari Sand Building Block/Brick Technology (KSBB) produces affordable but high-quality products (blocks and bricks) with respect to strength, durability and aesthetics. The KSBB mainly uses Kgalagadi sand, which covers about 75 percent of the surface area of Botswana, and a blend, which is a mixture of Ordinary Portland Cement and fly ash. These two components are mixed in the right ratio for each specific type of Kgalagadi sand.

The KSBB, is therefore, environmentally friendly, as it uses fly ash, which is an otherwise nuisance by-product for coal power producers. By using fly ash in its production, KSBB enables coal power producers to find a sustainable usage of potentially harmful by-product, while at the same time reducing costs of maintaining stockpiles of the same. The other eco-friendliness credential of the technology is that it requires no burning to improve strength, therefore saving on the consumption of fossil fuels, most of which are non-renewable. The blocks have a strength that ranges between 7 and 14 Megapascals (MPa), thereby, assuring the user of structurally sound and durable buildings.

The KSBB is Botswana Bureau of Standards certified under the BOS 592-1:2013 standard.



The Project Rollout

The outcome of the KSBB Technology Rollout Project shall be the establishment of twenty-nine (29) KSBB depots throughout Botswana. BITRI, as the originator of the KSBB Technology, has been tasked with the execution of this project. To date, six (6) KSBB depots have been established and are fully operational. These are located at Artesia, Kasane, Lehututu, Maubelo, Phitshane-Molopo and Takatokwane.

Currently, a total of one hundred and twenty-nine (129) artisans are engaged on a full-time basis, at the six (6) operational KSBB depots. Another five (5) KSBB depots are under construction at Charleshill, Ghanzi, Gumare, Maun and Tshootsa. Of these, the Ghanzi, Gumare and Maun depots are earmarked for commissioning in the near future. The KSBB is targeted at main and sub-councils, construction companies, estate developers, as well as members of the public, and demand for the product has grown since the inception of the project.

As testament to the quality of the KSBB, the product is being used in construction of selected structures at the Moshupa Primary Hospital construction project. The masonry units being used, in the form of blocks, are being produced at three KSBB depots, located at Artesia, Phitshane-Molopo and Takatokwane.

Production and Supply of KSBB Cement Blend

In a bid to ensure consistency in the quality of the KSBB-specific cement blend and ensure sustainability of the production and reliability of the supply of the cement blend to the designated consumers, BITRI has entered into a license agreement with Kago Phepa (Proprietary) Limited for the exclusive rights for the production and supply of the Kgalagadi Sand Building Block specific cement blend. Under this agreement, BITRI will provide all expert advice and skills required and would at times conduct random sampling for purposes of quality assurance.

This license agreement gives BITRI an opportunity to concentrate on its core mandate, which is to identify, develop and/or adapt appropriate technology solutions that provide sustainable innovative solutions through co-creation and collaboration in line with national priorities and needs of Botswana and indeed the SADC region.



MMUALEBE

CUSTOMER FEEDBACK | SURVEYS



User-friendly Graphics and Dashboards



Offline Capabilities



Customizable Surveys



Real time Access to Customer Feedback



Feedback Analytics for Strategic Decision-making

TECHNOLOGY

solutions that provide

SUSTAINABLE

Innovative Solutions



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