



## FACULTY OF SCIENCE

### ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE	IT00300/IT08X30 SOFTWARE FACTORIES
CAMPUS	APK
EXAM	NOVEMBER 2020

DATE: 2020/11/3

SESSION: 8:30 – 23:59

ASSESSOR(S)

Prof JJ Langerman

INTERNAL MODERATOR

EXTERNAL MODERATOR

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University of Nairobi, Kenya

DURATION: Take home exam

MARKS: 100

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THIS PAPER CONSISTS OF 6 PAGES INCLUDING THE COVER PAGE

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#### INSTRUCTIONS:

- This is an open book assessment.
- Read the questions carefully and answer only what is asked.
- Number your answers clearly.
- Only typed assignments will be accepted.
- Structure your answers by using appropriate headings and sub-headings.
- The general University of Johannesburg policies, procedures and rules pertaining to written assessments apply to this assessment.

## GENERAL NOTES

No references or generic discussions are necessary. Marks will be awarded for how the idea will be applied. For example, don't write: "A modern development language will be used together with Cloud technology". Rather say: "We will be hosting the analytics engine on AWS Cloud and the base language will be Python". Don't say "Work will be done by cross-functional teams." Rather say: "Work will happen in cross-functional teams consisting of designers, engineers that acts as coders and testers together with a scrum master."

As a general guideline, the proposal must use 1.5 line spacing, with font Arial and font size 11 point, pages numbered, and with an appropriate title/cover page. Work on 10 marks a page. Use headings and subheadings and even diagrams to ensure your ideas are clear.

**QUESTION 1**

An investor approached you to start a business that will utilise the technologies and thinking of the 4<sup>th</sup> Industrial Revolution. She forwarded you the attached article she read in The Economist (African countries must get smarter with their agriculture, *The Economist*, 26 March 2020).

Based on this she wants you to put a proposal together for a company that could address these problems. The proposal should consist of the following:

- 1) A high-level overview of the solution you propose utilising as many technologies of the 4<sup>th</sup> Industrial Revolution as possible. Also develop a North Star statement for the company. (5)
- 2) A strategy built on eco-system and platform thinking. (20)
- 3) A balanced scorecard that outlines how the organisation will be measured. (10)
- 4) A conceptual architecture view outlining the operating model considerations as well as the planner view of the Zachman framework. (20)
- 5) Discuss how you will achieve organisational agility across the organisation from the C-Suite to the delivery teams. (20)
- 6) Outline the specific engineering practises to enable this vision (10)
- 7) A service management model for the organisation (10)
- 8) Outline the specific culture you want to foster in the organisation (5)

**TOTAL: [100]**

## How Digital Technology Is Changing Farming in Africa

by Ndubuisi Ekekwe

MAY 18, 2017

Harvard Business Review

According to the Food and Agriculture Organization of the United Nations, the world population will reach 9.1 billion by 2050, and to feed that number of people, global food production will need to grow by 70%. For Africa, which is projected to be home to about 2 billion people by then, farm productivity must accelerate at a faster rate than the global average to avoid continued mass hunger.

The food challenges in Africa are multipronged: The population is growing, but it is threatened by low farm productivity exacerbated by weather changes, shorter fallow periods, and rural-urban migration that deprives farming communities of young people. In Northern Nigeria, herdsman are moving south looking for pasture as their ancestral lands face severe deforestation. In Somalia, the Shebelle River, which supports many farmers, is drying up, causing additional pains in the war-torn country. The combination of higher food demand, stunted yield potential, and increasingly worse farmland must stimulate a redesigned agro-sector for assured food security. Agriculture accounts for more than 30% of the continent's GDP and employs more than 60% of its working population.

For decades, African governments have used many policy instruments to improve farm productivity. But most farmers are still only marginally improving yields. Some continue to use traditional processes that depend heavily on historical norms, or use tools like hoes and cutlasses that have not evolved for centuries. In some Igbo communities in Nigeria, where I live, it's common for farmers to plant according to the phases of the moon and attribute variability in their harvests to gods rather than to their own methods.

Those that do look to leverage new technologies run into financial issues. Foreign-made farm technologies remain unappealing to farmers in Africa because they are cumbersome for those who control, on average, 1.6 hectares of farmland. What's more, less than 1% of commercial lending goes into agriculture (usually to the few large-scale farmers), so smaller farms cannot acquire such expensive tools.

But this is about to change. African entrepreneurs are now interested in how farmers work and how they can help improve yields. The barrier of entry into farming technology has dropped, as cloud computing, computing systems, connectivity, open-source software, and other digital tools have become increasingly affordable and accessible. Entrepreneurs can now deliver solutions to small-size African farms at cost models that farmers can afford.

For example, aerial images from satellites or drones, weather forecasts, and soil sensors are making it possible to manage crop growth in real time. Automated systems provide early warnings if there are deviations from normal growth or other factors. Zenvus, a Nigerian precision farming startup (which I own), measures and analyzes soil data like temperature, nutrients, and vegetative health to help farmers apply the right fertilizer and optimally irrigate their farms. The process improves farm

productivity and reduces input waste by using analytics to facilitate data-driven farming practices for small-scale farmers. UjuziKilimo, a Kenyan startup, uses big data and analytic capabilities to transform farmers into a knowledge-based community, with the goal of improving productivity through precision insights. This helps to adjust irrigation and determine the needs of individual plants. And SunCulture, which sells drip irrigation kits that use solar energy to pump water from any source, has made irrigation affordable.

Beyond precision farming, financial solutions designed for farmers are blossoming. FarmDrive, a Kenyan enterprise, connects unbanked and underserved smallholder farmers to credit, while helping financial institutions cost-effectively increase their agricultural loan portfolios. Kenyan startup MFarm and Cameroon's AgroSpaces provide pricing data to remove price asymmetry between farmers and buyers, making it possible for farmers to earn more.

Ghana-based Farmerline and AgroCenta deploy mobile and web technologies that bring farming advice, weather forecasts, market information, and financial tips to farmers, who are traditionally out of reach, due to barriers in connectivity, literacy, or language. Sokopepe uses SMS and web tools to offer market information and farm record management services to farmers.

Major global corporations have tried to advance digitalization of African agriculture by launching payment systems, credit platforms, and digital insurance. But to serve largely subsistence farmers, they have to compete against the local startups — particularly on cost of service in a highly fragmented business, with no easy path to scale, owing to illiteracy, language, border constraints, and native dogmas. The microentrepreneurs with a specific focus on their domains have inherent advantages.

While it is still early to evaluate the impacts of this digitalization of farming systems in Africa, in terms of productivity and improvement of human welfare, there is already a promising trend: Technology is making farming exciting for young people. As they see that developing mobile apps alone cannot feed Africa, many will turn to farming as a business.

But they must be ready to confront institutional challenges in the industry. Critical infrastructure is still required to truly digitally transform agriculture in Africa. The continent does not have a comprehensive soil map similar to the U.S. Web Soil Survey to provide soil data and information. The implication is that the smart farming startups must build such a map as they introduce their technologies across the continent. Alternatively, governments or the African Union could fund largescale soil map to accelerate precision farming.

Most of the farms are in areas with limited connectivity, making full technology integration in real time challenging. As countries such as Ethiopia launch satellites, considering how farmers can benefit from such initiatives will be critical. Improved farm connectivity will usher in a new dawn in agriculture technology in the continent.

But entrepreneurs will need to work with the people themselves. Norms and traditions are prevalent in African agriculture, and just as many farmers initially rejected inorganic fertilizers, fearing that they would irreversibly poison the land, individuals may be resistant to changing their farming methods. Agro-tech pioneers must turn farmers into believers by using field demonstrations to show that new technologies can deliver better results.

Finally, Africa needs to cut its food waste in regions where electricity is unreliable or unavailable. The biggest impact will come when the little that is produced can be effectively utilized through appropriate preservation and storage techniques. Pioneering affordable solutions on food safety and tracking food supply chains will boost the overall value of the sector. Digital technology opens vast untapped potential for farmers, investors, and entrepreneurs to improve efficiency of food production and consumption in Africa. From precision farming to an efficient food supply chain, technology could bring major economic, social, and environmental benefits. Indeed, the sheer optimism across the startup ecosystem is that extreme hunger can be cured in Africa, in this generation, by significantly transforming the industry that employs most of its citizens.