



MAHIKA 1 - GROUP PROJECT

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ABSTRACT

According to The agricultural sector needs to employ a wide range of evolving technologies and farm practices across many different farming systems and structures to meet a variety of changing and heterogeneous demands from consumers and the public for food, fibre and other goods and services provided by agriculture, often with uncertain outcomes in terms of their effects on sustainability. Innovation and technology management is an unavoidable subject in the high end technological and innovative organizations. Innovation and technology environment in companies are by nature, problematic, characterized by poor business models, political instability and governance conditions, low education level and lack of world-class research universities, an underdeveloped and mediocre physical infrastructure, and lack of solid technology based on trained human resources. Farmers will invest in and implement sustainable technologies and farm practices if they expect the investment will be profitable, if they have the right education, information and motivation, and if government policies set clear goals. Agricultural policies can alter, however, the prices facing farmers for their inputs and outputs, which in turn will influence their decisions on investment and can lead to unsustainable farming practices. Where the environmental benefits from employing sustainable technologies are not expected to accrue to farmers, but to people outside agriculture, and where there are no markets for the benefits, levels of adoption could be sub-optimal from a societal perspective. Equally, where the costs of environmental effects of current farming activities are paid by other sectors, farmers will have no incentive to adopt environmentally sustainable technologies. This paper provides a theoretical and conceptual framework analysis for managing innovation and technology for NWK Inc.

Key words: Technological Innovation, Technological Farming, Managing Technology, Marketing and Technological Road Map (TRM)

INTRODUCTION

Land and agriculture is influenced in various ways by climate change, such as increases in annual precipitation, average temperature, heat waves, and increases in weeds, pests or microbes, global changes in atmospheric CO₂ or ozone levels, and variations in sea level. Agriculture is considered, according to some prediction estimates, to be the most threatened activity adversely affected by climate change. Food security and ecosystem resilience are the areas of greatest concern worldwide to date. With declining water sources and a greater focus on resource conservation, irrigation technology is developing to make do with less. Although the initial capital cost of the new equipment and software may be high, it is not possible to beat its improved performance, higher yield and reduced water use. Irrigation supports 25% to 30% of national agricultural production in South Africa. Although irrigated agriculture uses 62% of the available water resources in South Africa, the importance of this sector for the economy and food security is undisputed

In South Africa, irrigation supports 25 percent to 30 percent of national agricultural production. Though irrigated agriculture accounts for 62% of South Africa's available water supply, the importance of irrigated agriculture to the economy and food security is unquestionable.

Commercial farmers are described as farmers that farm for profit and use modern technological means for sale in the market. The focus is on for the assignment is more on emerging small farmers.

Emerging small farmers are facing challenges of being unable to keep comprehensive records of their farming enterprises consequently are unable to prove viability of their farming business and as a result their credit worthiness is in most cases understated and they are unable to influence the missing middle in agricultural value chains. The data revolution helps us to settle on better choices in all parts of our lives, and farmers are no exemption. Nonetheless, the small-scale farmers being forsaken as most data applications are produced for commercial farming. There is a need for smallholder

farmers to use information and technology innovation (ICT) developments for improved productivity and efficiency. Noordwes Koöperasie (NWK) Group is a company chosen for the assignment. A brief background of the company and current technologies that are used are discussed and further proposing other technologies that will assist the emerging farmers to grow their business using the fourth industrial technologies which are - Artificial Intelligence, Blockchain, augmented reality and IoT.

BACKGROUND OF THE COMPANY

Noordwes Koöperasie (NWK) Group is an agricultural private company based mainly in the North West Province. It's has been existing for more than a century. It contributes to food security in South Africa and its main objective is to trade in agricultural and related products, aids and services at a retail level and to undertake associated activities. Their mission is to help individuals, families, as well as organizations, fulfill their unique financial goals through objective, informed investment, and retirement plan oversight and management. They provide variety of products and services mentioned below:

- Production Inputs: Seeds, dry fertilizer, plant nutrition, agrochemicals, mechanization, etc.
- Grain services: Dry beans, grain trading, storage and handling, etc.
- Financing: Term loans, production accounts, livestock loans, months accounts
- Insurance & Financial services: Short-term insurance, crop insurance, financial planning, life insurance, medical funds, funeral schemes
- Farming technology: Access 4 Africa Exchange, NWK online

CURRENT SYSTEM USED BY THE COMPANY

Farmers both commercial and smallholder are their major customers; they have a great number of clientele on their books. In terms of technology they using currently, NWK Group offer the mobile application through which they manage communication with their customers. Customer can check the status on their contracts, monitor their balances,

check the latest prices, compare performance with other producers, etc. on the mobile application.

PROPOSED INFORMATION TECHNOLOGY STRATEGIES TO BE USED

1. Internet of Things

IoT is basically the connection of things or objects and humans to each other through the internet. Technically, IoT is when “things” which have remote sensing or actuating capabilities exchange data with other connected devices and applications, the collected data is either processed locally (local servers) or through the cloud (Cloud servers). IoT is an improved collection of information, the interaction, the transaction and the resultant action which is added to the Internet through devices which are equipped with data sensing, analysis and communication capabilities, using Internet technologies (IEE 2015: 19).

For IoT to be possible, it will need the following conditions: 1. Internet technology to enable for communication 2. RFID technology which requires a tag with the information of the object, a reader of the tag, an interrogator, and a backend system 3. Sensor network technology 4. Wireless communication systems which shares the information with the centralised system 5. The embedded technology which is internet based for the interpretation of the data (Yu: 2015, 1664). Different companies from different sectors are adopting IoT technology to simplify, improve, automate, and control different processes.

Weather changes have made farming not be dependent on rain to secure food for the nation. Farmers need to harness the power of the internet to enhance their activities. Through the internet of things (IOT); a system has to be developed that will have sensors in the field that will be connected to an operating system (OS) which reads the moisture content. If the soil is too dry, the sensors will send a signal to the OS; which will liaise with the weather prediction in the next 24 hours, if possibility of rain is zero,

the OS will send the signal to the Irrigation system, which will automatically provide water, and only the recommended amount of water by the OS will be sprayed. A report to the farmer will be communicated through her/his smart phone of the activity. Currently farmers have to check the website for weather predictions, which is time consuming, and have to physically switch on the irrigation system, and use rule of thumb on how much water to put.

2. Augmented Reality

Augmented farming (AF) is a term created by our technology startup “Augmenta” and is a farming management concept which is solely based on 1)high definition 2)close range 3)hyper-spectral imagery that can digitally model fields.

Farmers are able to track the performance of their farm or business anytime and anywhere. Through the system, time will be saved to reduce labour costs and which will lead to increased profits for the farmers. This system will assist black farmers to emerge from being smallholder to commercial farmer, non-default payment on their NWK accounts, and are able to purchase their own mechanisation instead of borrowing from fellow farmers which delays production. NWK has the capacity of IT specialists who can work on the system, and can collaborate with IT firms to provide resources needed.

3. Artificial intelligence

The increase of digital agriculture and its related technologies has opened an affluence of new data opportunities. Remote sensors, satellites, and UAVs can collect information 24 hours per day over an entire field. These applications have capabilities of monitoring plant health, soil condition, temperature, humidity, etc. The amount of data these sensors can produce is overwhelming, and the importance of the numbers is concealed in the avalanche of that data.

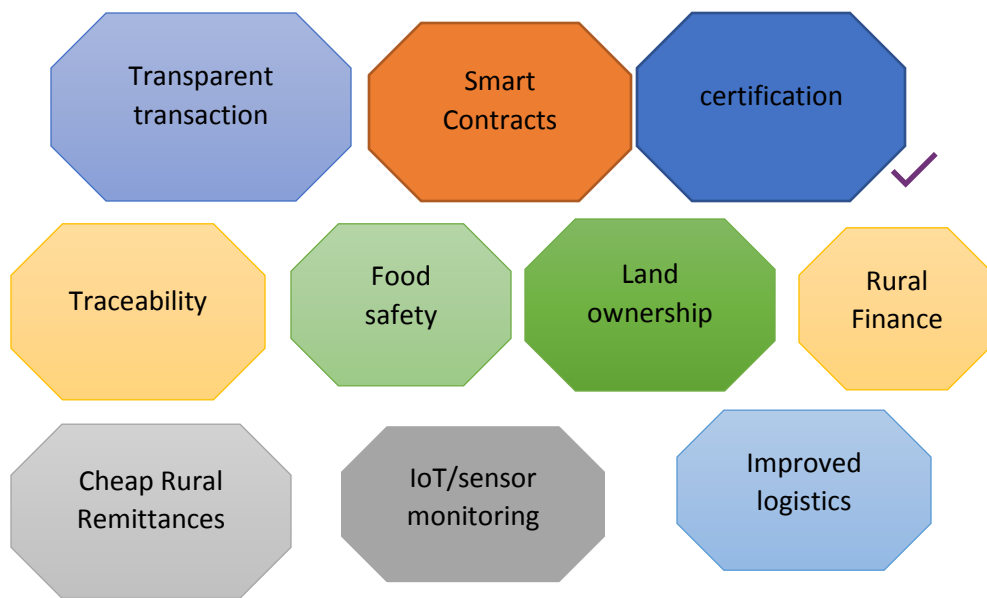
The idea is to permit farmers to obtain a better understanding of the state of affairs on the ground through advanced technology such as remote sensing that can inform them more about their situation than they can see with their bare eye; and not just more

accurately but also more quickly than seeing it walking or driving through the fields. Remote sensors allow algorithms to analyse the field's environment as statistical data that can be understood and valuable to farmers for decision-making. Algorithms manipulate the data, adapting and learning based on the data received. The more inputs from farmers and statistical information collected, the better the algorithm will be at predicting a range of outcomes. The goal is that farmers can use this artificial intelligence to achieve their goal of a better harvest through making better decisions in the field.

4. Blockchain

Block chain is one of the precision technologies that is suitable to provide answers to a number of issues in agriculture, from farmer IDs to smart contracts, from traceability and improving certification, digital payments, insurance, consumer feedback and improved logistics. NWK as an organisation that is driven by client-orientation and the reinforcement of partnerships at several levels, the company offers financing, agricultural inputs, grain market participation, advisory services, and farming technology. The use of blockchain at NWK will comprise of five or six predictable, repeatable processes that fit themselves well to automation, namely:

- A supplier buying or leasing the processing tools;
- The transfer of credit from the fund to the supplier;
- The supplier buying the fresh produce of the farmer;
- The processing of the fresh produce by the supplier;
- its registration or certification
- and the sale of the processed food to an exporting company



Blockchain is capable of tracking ownership record and tamper-resistance can be used to solve challenges such as food fraud, safety recalls, supply inefficiency and food traceability in the existing food system. Blockchain's exclusive decentralized structure creates a market for premium products with transparency by ensuring that products and practices are verified. A Blockchain application has come in hand as solution to food tracing. Food traceability has been the most important issue on the recent food safety discussions. Owing to the nature of perishable food, the whole food production is exceptionally vulnerable to making mistakes that would eventually affect human lives. When foodborne diseases pose public health risk, the first utmost important thing to root- cause analysis is to identify the source of contamination. The current communication within the food ecosystem makes traceability hard and time-consuming task since some parties are still tracking information on paper. The Structure of blockchain guarantees each party along the food value chain would generate and solidly share data points to create an accountable and traceable system. Extensive data points with labels that clarify ownership can be recorded instantly without any changes. Consequently, the record of a food item's journey from far to table is accessible to monitor in real time.

The integration of block chain in farming sector particularly in food chain extend beyond ensuring food safety. It also augments value to the existing market by creating a ledger in the network and balancing market pricing. The conventional price mechanism for

buying and selling depends on judgments of the involved players rather than the information supplied by the entire value chain. Providing access to data would create a comprehensive picture of supply and demand. The Blockchain application for trades might transform traditional commodity trading. Block chain allow verified transactions to be solidly shared with every player in the food supply chain.

THE PROPOSED IT SYSTEM TO BE USED BY NWK IS THE AGRIFARMIS

AGRIFARMIS combines both analogue and digital platforms to capture and manage records that include farm book, Production Information Agents (PIAs), online portal and mobile phones. The AGRIFARMIS solution is put up around a farmer driven data collection and collation system. Through a network of Production Information Agents (PIAs), farmers complete a farm book that captures data throughout the production period of the season, and then enters the data into a centralized digital database. Mobile phones are used to capture primary data that includes farmers' profiles which are uploaded to the online portal.

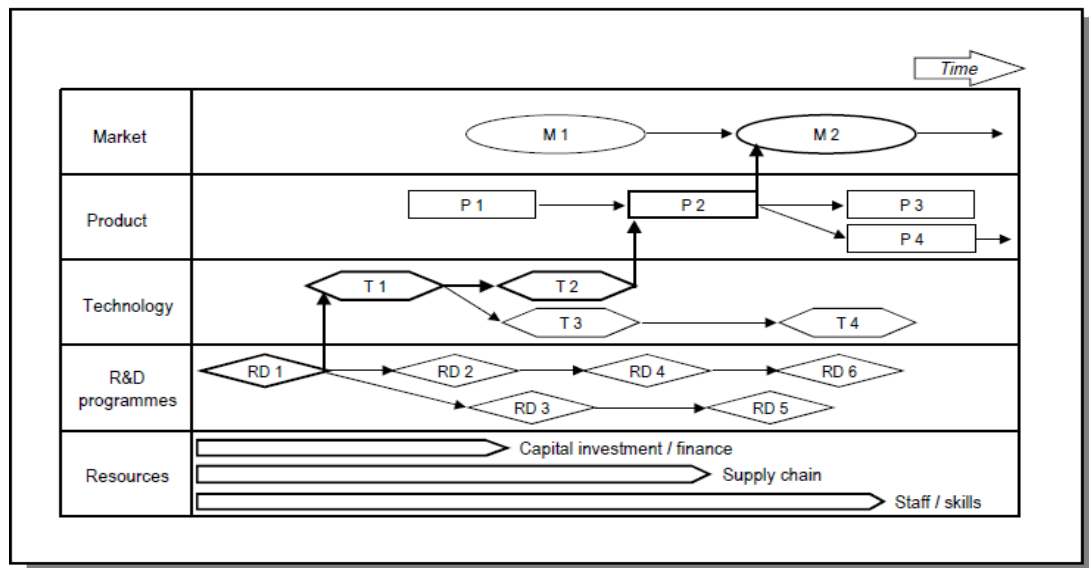
Roadmap of NWK

Technological road mapping applies to many kinds of forecast studies, such as visions and accurate expectations of potential future developments in technology, products or environments. It is a basic technique for technology planning, which functions within a wider planning activities context. In many environments, it is accepted, including physical and service product planning, product family tree creation, and program planning.

The (TRM) technique is commonly used in the industry. TRM's primary function is to support the management and preparation of technology. TRMs are used in a business setting to clarify the roadmap for the progression of a successful business strategy, linking it to the creation of product features. TRM typically consists of time-based multi-layered charts that enable technical advances to be synchronized with market trends and drivers. It can take different forms, but in the generic form suggested by EIRMA

(1997), the most common strategy is encapsulated. - see Figure below. A time-based chart, containing a variety of layers that usually contain both commercial and technical viewpoints, is the traditional roadmap. The roadmap makes it possible to analyze the evolution of economies, goods and innovations, along with the relations between different perspectives.

Figure 2: Schematic technology roadmap



The successful implementation of the road map follows the following four steps model: -

1. Technology Identification

The identification of the most suitable, appropriate and efficient technology is an important activity which helps organizations to achieve their goals and remain competitive through creating new products or services or processes, improving current ones, working on patents, innovation and reducing costs.

There are two methods of identifying a new technology:

- Start with a problem which requires a solution and review the new technologies available to eventually solve it.

- Identify an innovative technology originating in a completely different sector which may be of potential interest for an application in other domain and may create new market opportunities.

Climate change was identified as a serious concern which is negatively affecting the farming community in various ways. The fields are dry and thereby making farming unsustainable and lesser harvesting. The combination thereof threaten food security for both humans and animals which could have very devastating effects to life on the planet. The dams and rivers are also drying up because of poor rainfall.

The little amount of available water becomes a very crucial commodity which we have to use as sparingly as possible to be able to sustain the animals, plants and humans on this planet. It has therefore become very important that no waste of water should be allowed during the irrigation process. The use of the 4IR technologies would therefore greatly assist to achieve the maximum efficiency of this water resource.

2. Technology Acquisition

AgriSigTM, a remote sensing company in which NWK holds a 50 percent stake and FARM Agricultural Enterprise Management (Pty) Ltd (FAEM) holds the remainder, has been identified as an important stakeholder to assist with the development of the technology to develop the 4IR compliant system. The Research and development will also do a feasibility study to establish whether there is enough capacity within NWK to be able develop the technology. The firm's absorptive capacity involves the following:

- Its level of technical knowledge concerning the technology to be acquired
- NWK 's level of experience in acquiring technology and its own R&D capabilities
- Its stock of intellectual property relating to technology to be acquired
- Its willingness to accept new ideas and technologies from outside the organization
- Its flexibility in adopting new routines
- Internal support

- Sharing knowledge with external partners
- Applying acquired technology in new products
- Exploitation of the technology

A startup business to partner with AgriSigTm would rather be a preferred choice over total outsourcing for the reasons as follows:

- Novelty - Startups have ~~more~~ novelty than big businesses, and people crave novelty in their purchases and daily lives. It makes you more surprising, more interesting, and oftentimes, more valuable, by sheer virtue of the fact that you're a relative unknown.
- Agility - Big businesses are often forced to make decisions via bureaucracy or with teams of people, making them slower and less able to adapt. To make matters worse, they have ~~to~~ keep their existing customers happy or risk ruin. Startups are much faster and nimbler, giving them more opportunities to change and grow
- Loyalty - When people buy from a startup, they're more likely to stay loyal. This is especially true in a local ~~environment~~, where supporting small businesses is greatly encouraged.
- Individuality - Startups tend to have ~~more~~ character. This is partly due to the fact that they are managed by just a small number of individuals, and partly because they have not had much time to grow.
- Teamwork - Startups are finally operating with smaller, tighter-knit teams. This makes group decisions easier ~~to~~ make, which generally contributes to a more immersive, fun, rewarding work atmosphere.

3. Technology Exploitation

New technology exploitation is defined as the utilization of new technology or scientific developments to improve the performance of products ~~or~~ manufacturing processes. Lying between knowledge creation and the traditional new product development processes, it is an iterative process that requires its own set of management tools.

- The technology exploitation could take the following routes:
- In-house development whereby the production and distribution of technology are carried out within the company.
- Joint commercialization: production and distribution are carried out in collaboration with other organizations through joint ventures or other form of alliance.
- Selling technology: can take place at any stage of the technology development, including idea, prototype, patent and license sales.

The preferred option for NWK is the joint commercialization. NWK through its technology arm the AgriSigTm in collaboration with the identified with using various platforms to market the product. The marketing mix which comprises the four P's, that is the price, place, product and the promotion should be integrated into the plan.

4. Technology Protection

Pre-transfer Activities:

- A formal technology transfer relies on legal documentation, a contract including binding conditions on what will be transferred, between whom, when, how and for what price.
- After a contract is prepared either by the developer or the receiver, it is jointly negotiated and a formal form is reached.
- Before the technology transfer starts, there might be a number of adjustments to physical facilities and workforce depending on the location, infrastructure and expertise.

Human Resources

Now that an idea has been defined, the most important next in line is the employees. They will be more open to the idea of a new IT system. They will be able to provide insights on what will work for them and what won't. Employees will be more open to

providing inputs from their end. This will increase their feeling of self-worth. Employee involvement increases their feeling of security that they won't lose their job or lag behind because of new technologies. Proper training will also enhance the employee's performance and better the chances of system success. Involving and employees assists in terms of embracing the idea and selling the same to customers as they do their interactions. The system will allow staff to log on ✓ with passwords linked to their individual profiles thereby allowing enough segregation of duties.

FACTORS INFLUENCING THE COMPETITIVE ADVANTAGE IN THE NEW TECHNOLOGY

Enhanced Production	Enhanced access to trade and markets	Enhanced access to Financial
a) Agro-climate forecast	a) Suppliers ✓	a) banking
b) Diagnostic and advice	b) certification	b) Insurance
c) Soil- water	c) Traceability	c) Microfinance
d) Pests and diseases	d) inputs	d) Credit
e) Early warning	e) Price	e) Money transfer
	f) Market information	

IMPLEMENTATION AND MANAGEMENT OF TECHNOLOGICAL INNOVATION

Resources needed for the proposed ✓ technology:

- To enhance the department, competent personnel with the skills in IT will be essential, software developers for the system, programmers to integrate software

with customers, IT hardware and installation personnel to be deployed in the field, personnel to monitor the system as it goes live;

- Finance department to collect revenue, depending on the business model, subscription based or licence fee route; ✓
- The software can either be outsourced from the cloud offerings, or be developed in-house. Either way a system will be needed; ✓
- Drones will be required to gather state data to augment Satellite images, to monitor the health of the crops;
- Sensors to pick the moisture content of soil;
- Irrigation systems;
- Intranet for communication with the customers; ✓
- Internet connectivity; and
- Solar power or generators as back-up power.

NWK will collaborate with IT firms, Satellite companies, South African Weather Services, and universities for specialised skills as internships. They will also partnership with the commercial banks to provide capital for farmers for installation costs and repayment combined with monthly subscription fees. ✓

The launching and marketing of technology will be done through existing NWK mobile application, direct marketing within NWK retail stores, farmer's forums, expo's, and magazines. NWK will implement Customer Relationship Management (CRM) which will provide support and prompt response ✓ to farmers, and continuous improvement of the system. The system will be piloted to selective farmers to test the effectiveness.

Change is always viewed either as positive or negative in any organization. The top leadership of NWK should adopt either the 8-step process for leading change or ADKAR Model. The basis of both models is to sustain the need for the change in the strategic direction of the organization, to prepare for the change, and then implement it sustainably. The employees and all stakeholders ✓ should firstly be aware of the reasons for the change. For NWK to survive, it has to adapt and evolve and most important be innovative; this should be one of their driving points.

The leadership should enlist the desire and support of the staff in the new direction, and brief staff on their new roles during and after the change. For most employees will have fears that the new strategic intent might render them useless and fall in the resistance to change trap. Small group of volunteers for the hanging fruits and who will be rewarded should be enlisted as a priority.

Constant communication with employees about change will make them feel involved in the processes and reward to those who embrace the change will give motivation to others. Resistance to the change will be inevitable, and to counter this, counselling should be organised for all employees with fears.

NWK should move from the traditional bureaucratic functional organizational structure to a more matrix structure, where combinations of functional and divisional elements are combined. Matrix structure not only groups people according to their functions, but further divides them into project structures with cross sectional duties. Finance from the traditional NWK group can be roped in the development and management of the IT department licence fee model as a project.

Organizational Restructuring

- IT department to develop more features, such as the supply chain for the farmers, and delivery.
- Innovation to be rewarded in the organization. ✓
- Team structure, where employees are given free rein to do their jobs and be encouraged to try to do things in a different way.
- To do away with chain of command so as to reduce red tape.

ACTION NEEDED TO EFFECTIVELY MANAGE TECHNOLOGY INNOVATION

- To promote enabling environments and uptake of ICT solutions to respond to the needs smallholder farmers.

- Strengthen the capacity of small-scale farmers to use ICTs.
- Improve the training and ICT proficiency of national extension agents.
- Use ICTs to deliver data-driven products and services and develop associated business models that drive improved productivity, profitability and resilience of farmers.

HOW WILL THE NWK GROUP BENEFIT FROM THE SYSTEM

The benefits are going to be mutually beneficial for the farmers and NWK:

- NWK would have increased revenue due to improved sales of the proposed products.
- A decline in losses because of farmers being able to pay their loans and insurance products.
- The farmers will benefit from increased harvest due to real time monitoring gadgets and responsive software. Better risk mitigation and management of farm activities.

Technological Farming: Supply Chain Management

As the mobile devices became popular and many people started having them including farmers as it allowed them to stay connected while in the field and access to data needed on-the-go. The decisions on what is needed is based on the information on hand, that is why data has helped in harness the power of information to make better-informed decisions that allow to use resources more sustainably. Farmers can plan for better harvests and make better decisions with information on hand.

NWK can have plans on developing supply chain management feature, whereby farmers are able to place orders for seeds or fertilizer at any time or in any place using their devices. Basically supply chain management should be incorporated on their mobile app and inclusive of distribution options. Supply chain management is crucial to any organisation and therefore requires accurate

information. Digitisation of supply chain will keep NWK sustainable and innovative, highest levels of customer experience will be maintained, cost reduction, and prepared for the future for technology that will come.

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Technological Innovations for Agricultural Developments through Information Communications Technology (ICT) ^{*1}

1

Results

overall comment = 1

General Marks = 59

Total = 60

Feedback

*1: As a group you could have done a better job by researching extensively