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Information technology in a global society

Higher and standard level

Paper 2

15 pages

Using assessment criteria for external assessment

For external assessment, a number of assessment criteria have been identified. Each assessment criterion has level descriptors describing specific levels of achievement, together with an appropriate range of marks. The level descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description.

Examiners must judge the externally assessed work at SL and at HL against the four criteria (A–D) using the level descriptors.

- The same assessment criteria are provided for SL and HL.
- The aim is to find, for each criterion, the descriptor that conveys most accurately the level attained by the candidate, using the best-fit model. A best-fit approach means that compensation should be made when a piece of work matches different aspects of a criterion at different levels. The mark awarded should be one that most fairly reflects the balance of achievement against the criterion. It is not necessary for every single aspect of a level descriptor to be met for that mark to be awarded.
- When assessing a candidate's work, examiners should read the level descriptors for each criterion until they reach a descriptor that most appropriately describes the level of the work being assessed. If a piece of work seems to fall between two descriptors, both descriptors should be read again and the one that more appropriately describes the candidate's work should be chosen.
- Where there are two or more marks available within a level, examiners should award the upper marks if the candidate's work demonstrates the qualities described to a great extent. Examiners should award the lower marks if the candidate's work demonstrates the qualities described to a lesser extent.
- Only whole numbers should be recorded; partial marks, that is fractions and decimals, are not acceptable.
- Examiners should not think in terms of a pass or fail boundary, but should concentrate on identifying the appropriate descriptor for each assessment criterion.
- The highest level descriptors do not imply faultless performance but should be achievable by a candidate. Examiners should not hesitate to use the extremes if they are appropriate descriptions of the work being assessed.
- A candidate who attains a high level of achievement in relation to one criterion will not necessarily attain high levels of achievement in relation to the other criteria. Similarly, a candidate who attains a low level of achievement for one criterion will not necessarily attain low achievement levels for the other criteria. Examiners should not assume that the overall assessment of the candidates will produce any particular distribution of marks.
- The assessment criteria must be made available to candidates prior to sitting the examination.

Theme: Medical delivery drones in Rwanda

Criterion A — The issue and stakeholder(s) **[4]**

1. (a) Describe **one** social/ethical concern related to the IT system in the article.

Note to examiners: The concern may relate to its impact or result or consequences or effect or outcome.

*Award **[1]** for identifying the concern (which does not have to be stated explicitly). Mark the first concern only (if there are two or more).*

*Award **[2]** for a description of the concern that must be stated explicitly.*

Social/ethical concerns may include:

- **Reliability**: reliability of the cell/mobile phone signal (an unreliable signal may mean the request is not received/the drone arrival is not announced), the operation of the drone (an error in the programming may prevent the drone functioning). Availability of internet connectivity (for internet based messaging).
- **Reliability**: accuracy of the GPS signal (inaccuracies in the GPS coordinates could mean the drone does not reach its target).
- **Reliability:** drone operation, GPS signal and Text/internet connectivity in extreme weather.
- **Reliability:** when package might exceed the maximum weight limit that could affect the flight path of the drone (the drone may not reach its target)
- **Privacy**: medical delivery drones may be flying over forbidden areas – drones could be misused to gain information relating to national security. Transmitted information by text message - data such as location and blood type/medicines to be delivered (for example, HIV medicines).
- **People and machines**: the pilot's responsibility and ownership of the flight which relies on the drone operator as he/she sets the flight path – (an inaccurate flight path would result in the drone not reaching its target)/operators and doctors may need special training.
- **Policies**: local governments may need to regulate the operation of the drone to maintain a safe air space – (without regulation, drones could interfere with other aircraft).
- **Equality of access/Accessibility:** range of drone (diagram is 80km one way) may exclude some patients. Cost of drone service/medical supplies/cost of the equipment.
- **Security:** such as the drone being taken over or disabled by third parties – (the lifesaving medicines would not reach the patient).
- Reliability: the navigation system of the drone cannot be guaranteed to deliver the package in a usable condition (which means it cannot be used by the health care worker). .

(b) Describe the relationship of **one** primary stakeholder to the IT system in the article.

Note to examiners
*Award **[1]** for identifying the stakeholder (who). Mark the first stakeholder only (if there are two or more).*

*Award **[2]** for describing how the stakeholder interacts with the IT system **or** what part of the IT system relates to the stakeholder.*

Primary stakeholders may include:
- Doctors/healthcare worker (as per article)/Health care centre who use a cell/mobile phone to generate the request and will receive the medical resource through the delivery of the request by the drone.
- Patients who are the recipients of the medical delivery by the drone / whose data is in the database.
- Facilities staff who receive the medical request, and handle and package the request.
- Flight operator who fixes the package to the drone.
- government departments who are responsible for regulating the use of drones and setting rules for their use in healthcare
- Government departments who are responsible for regulating the use of drones and setting rules for their use in healthcare.
- Third parties who may intercept or take control of the drone.
- Developer/Developer company responsible for the hardware/software and who have a responsibility to ensure its security and reliability.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1	Either an appropriate social/ethical concern **or** the relationship of one primary stakeholder to the IT system in the article is identified.
2	Either an appropriate social/ethical concern **or** the relationship of one primary stakeholder to the IT system in the article is described **or** both are identified.
3	Either an appropriate social/ethical concern **or** the relationship of one primary stakeholder to the IT system in the article is described; the other is identified.
4	Both an appropriate social/ethical concern **and** the relationship of one primary stakeholder to the IT system in the article are described.

Criterion B — The IT concepts and processes **[6]**

2. (a) Describe, step-by-step, how the IT system works.
IT system: Text messaging, GPS, drones

*The major steps are the use of the **components** of the IT system: smartphone, texting, GPS positioning.*

Note to examiners

*Award **[1]*** if there is some understanding of the process but NOT in a step-by-step approach using the information **within** the article with possibly some steps missing.

*Award **[2]*** if there is a logical step-by-step account using the information **within** the article (but it may lack some detail).

*Award **[3]*** if there is a step-by-step account that *identifies information about how the IT system works that goes **beyond** the article.*

*Award **[4]*** if there is a step-by-step account that *describes information about how the IT system works that goes **beyond** the article.*

Answers provided in the article include:

- doctor pushes “send” (text message with request through cell/mobile phone)
- text message is received at the response centre/medical warehouse
  Accept either cellular or internet based messaging requiring internet connection
- loads package to the drone
- loads destination GPS coordinates algorithm to the drone
- a text message alerts the doctor on site just before the drone arrives
- drone uses onboard sensors to measure wind and judge speed for final approach
- drone releases its payload by disposable parachute
- drone returns to base.

Additional information that goes beyond that provided in the article may include:

- verification of the request *e.g.,* requesting phone number is checked in a database against registered users
- authenticates the user
- selects from warehouse stock via database/data warehouse
- both the cell/mobile phone and the drone use GPS satellites to trilaterate (accept triangulate) their position– Enhanced GPS and GPS coordinates of the destination are stored
- drone continuously sends GPS coordinates of its current position back to base
- identification of the nearest medical warehouse based on the requester's cell/mobile phone location
- drone pinpoints its base position using GPS and flies to the destination GPS coordinates
- system alerts air traffic controller about the upcoming flight
- medical request requirements (for example: items packed individually, appropriate temperature, fragile, *etc*)
- package drop-off minimal requirements
- local doctor may have to text to confirm delivery.

(b) Explain the relationship between the IT system and the social/ethical concern described in **Criterion A**.

Note to examiners
*Explaining the link between the concern and specific parts, or whole, of the IT system means the candidate must include **how** and **why** the concern has arisen from the use of the IT system. The concern identified in Criterion A may be implicit.*
*There **must** be a link to the concern identified/described in Q1(a).*

*Award **[1]** If the relationship between the concern and the IT system is identified. This may be a repeat, or rewording, of the response to Q1(a) or lack of detail for the how **or** why.*
*If there is more than one concern identified in Q1(a) accept **any** concern (i.e., preventing a follow through error).*

*Award **[2]** if how **or** why the concern that has arisen is described. Appropriate IT or ITGS terminology is used.*

For example, using a privacy concern, responses need to explain:

- *HOW the data can be accessed (e.g., interception of the WiFi signal is achieved)*

  OR

- *WHY it is possible to access the data (e.g., lack of encryption of the WiFi signal)*

- **How** – **reliability** of the cellphone signal / internet connection to make the request, loss of connectivity.
- **Why** – loss/interference of cellphone signal during the transmission and system is unable to identify its location (GPS destination coordinates).

- **How** – **reliability** of the operation and function of the drone, loss of connectivity/interference.
- **Why** – operators may not be aware of the connectivity boundaries that can lead to a potential risk of interference causing loss of control. Also, a drone's battery/life may be insufficient to complete a flight. Resilience of the drone for weather events/conditions.

- **How** – **reliability** ,GPS signal loss occurs in built up areas or due to the degradation of a signal caused by the electromagnetic interference of the leading edge of a storm front, rain fade.
- **Why** – low power of the GPS signal can be absorbed by structures and other features, impacting on the accuracy and reliability of the positioning systems.

- **How** – **privacy**, Medical delivery drones may be misused (forbidden locations as airports, forest fires, *etc*).
- **Why** – consciously (flight path programmed to fly over forbidden areas) or unknowingly not following regulations.

- **How** – **policies** to maintain a safe air space.
- **Why** – consciously or unknowingly (*eg* not including in flight program the maximum altitude for drones, resulting in drones invading airspace of commercial planes) not following regulations.

- **How** – **security** concerns, such as the drone being taken over or disabled by third parties.
- **Why** – lack of network security allowing hackers to intercept, reprogram and redirect the drone.

- **How** – **reliability** concern due to an excess of package load.
- **Why** – consciously or unknowingly not following drone load capabilities.

- **How** – **Reliability** (accuracy) is affected by programming.
- **Why** – Programming needs to account for weather factors that may impact accuracy.

- **How: Digital divide**, software and system is proprietary, or service is a subscription-based service.
- **Why:** Service is unavailable if the subscription/costs are not paid (there is a clear link in 2A to the technical developments).

Note:
Candidates are expected to refer to relevant stakeholders, information technologies, data and processes.
Candidates should explain to "how the IT system works" using appropriate IT terminology.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	There is little or no understanding of the step-by-step process of how the IT system works and does not go beyond the information in the article. The major components of the IT system are identified using minimal technical IT terminology.
3–4	There is a description of the step-by-step process of how the IT system works that goes beyond the information in the article. Most of the major components of the IT system are identified using some technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is identified, with some use of ITGS terminology.
5–6	There is a detailed description of the step-by-step process that shows a clear understanding of how the IT system works that goes beyond the information in the article. The major components of the IT system are identified using appropriate technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is explained using appropriate ITGS terminology.

Criterion C — The impact of the social/ethical issue(s) on stakeholders [8]

3. Evaluate the impact of the social/ethical issues on the relevant stakeholders.

Note to examiners
Mark holistically using a two-step process:

1. *Determine the markband the response falls into.*
2. *Determine the level within the markband using the guidelines below.*

Impact - result/consequence/effect/outcome on stakeholder which can be positive or negative

The evaluation should focus on the overall impact on the stakeholders. Evaluative comments may be within the body of the analysis or as a final summary.

Band 1 - 2

*Award **[1]** for at least one impact identified.*

*Award **[2]** for at least one impact described or more than one impact identified*

Band 3 - 5

*Award **[3]** for a limited analysis (such as the division into groups (privacy issues, security issues), or the impact on different stakeholders).*

*Award **[4]** for an incomplete analysis (such as mainly positives **or** mainly negatives).*

*Award **[5]** for a balanced analysis that includes connections (such as between positive and negatives or between impacts on different stakeholders). There may be limited evaluative statements.*

Band 6 - 8

*At least **two** stakeholders are required*

*Award **[6]** for a balanced analysis of the impacts that includes substantiated evaluative comments.*

*Award **[7–8]** for an overall evaluation supported by explicit references to the analysis of the impacts (this is not a repetition or summary of the analysis). The evaluation shows evidence of insightful thinking.*

Positive impacts may include:
Medical delivery drones save lives
- permit entry to areas that would be inaccessible/hazardous
- timely delivery of goods due to overcoming road congestions
- provide necessary medical resources, thus enabling doctors to provide better treatment.

Negative impacts may include:
Business and Employment
- loss of jobs as drones take over the delivery of goods. but different jobs are created *eg* drone operators/programmers.

Reliability
- reliability of the hardware/software due to weather conditions – which could endanger lives
- limited range of the WiFi signal – endangering people/possible loss of the drone
- reliability of the GPS signal – impacting on the accuracy of the drone's operation
- reliability of package quality assurance.

Security concerns such as the drone being taken over or disabled by third parties
- drone itself may be stolen – implications of access to medical resources
- drone may be used to endanger people on the ground due to loss of control/ deliberate intent by the third party to crash the drone or endanger people.

Safety concerns where drones are used inappropriately (*eg* near airports, over forest fires, overcrowded areas such as sporting fixtures)
- drone owners may not be aware of the regulations or choose not to follow them as they feel they have little chance of being caught.

Inappropriate use of the drone may
- impede the work of emergency services (*eg* fire services unable to fly over forest fires due to presence of drones
- cause a dangerous situation near airports; aircraft may be at risk of collision with drone and possible life-threatening damage (*eg* drone getting sucked into an aircraft engine); may result in flights being delayed/diverted
- the drone may be operating within restricted airspace – inexperienced or unqualified drone operator may not be aware of restrictions
- disrupt sporting fixtures or outdoor events; progress of the event may be held up by the presence of a drone; possibility of drones crashing into crowds and causing injury; possibility of drone causing an accident by obstructing or distracting people participating in the event.

Privacy
- the drone may be used as an improvised weapon or surveillance device by terrorist groups/may be used as a mechanism for illegal activities (delivering drugs/weapons *etc* to restricted areas).

Scalability
- provide worldwide service
- regulation of this service.

Examiners should reward suitable responses that are not included in this mark scheme. Before awarding marks, please check with team leader.

Please see the criterion level descriptors on page 12

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	The impact of the social/ethical issues on stakeholders is described but not evaluated. Material is either copied directly from the article or implicit references are made to it.
3–5	The impact of the social/ethical issues on stakeholders is partially analysed, with some evaluative comment. Explicit references to the information in the article are partially developed in the response. There is some use of appropriate ITGS terminology.
6–8	The impact of the social/ethical issues on stakeholders is fully analysed and evaluated. Explicit, well developed references to information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.

Criterion D — A solution to a problem arising from the article **[8]**

4. Evaluate **one** possible solution that addresses at least **one** problem identified in **Criterion C**.

Note to examiners

The problem should be stated in the box above the response. However, if this is not done, a solution can be evaluated that addresses any problem identified in Criterion C.

*The solution must be **feasible**.*

If there is more than one solution, mark the first solution only.

Mark holistically using a two-step process:

1. *Determine the markband the response falls into.*
2. *Determine the level within the markband using the guidelines attached.*

*The solution may be a series of **related** measures that address the problem identified. For example, if the candidate identifies a problem such as security and then includes a range of security measures that are grouped together, this is acceptable.*

If there are more than one solution, and there is no explicit connection between them, only mark the first solution.

Band 1 - 2

The link to the problem may be implicit.

*Award **[1]** if a solution is identified.*

*Award **[2]** if a solution is described.*

Band 3 - 5

The solution is explicitly linked to the problem.

*Award **[3]** if the solution described and there is at least one evaluative statement.*

*Award **[4]** if the solution described has limited evaluative comments about the strengths and weaknesses of the solution.*

*Award **[5]** if the solution described has evaluative comments that address a range of strengths **and** weaknesses.*

Band 6 - 8

There are explicit references to the article throughout the response.

*Award **[6]** for an overall judgement about the effectiveness of the solution.*

*Award **[7-8]** for an overall judgement about the effectiveness of the solution that is supported by the evaluation of its strengths and weaknesses. Future developments may be proposed and/or insightful thinking demonstrated.*

Answers may include:

Solutions to the Security of the system or privacy of data

- Regular maintenance of the drones and system, back up of systems, patching and updates
- Providing firewall at the central base
- Encryption of transmitted data (messaging) and stored data (database)
- Authentication of the messaging/request
- Developing policies or laws to specify security/data protection requirements

Solutions to the reliability of the system

- Running a simulation to ensure viability of the proposed flight plan
- Regular maintenance of the drones and system, back up of systems, patching and updates
- Additional sensor/s to improve accuracy and reliability
- Improvements to the drone, delivery mechanism or messaging system

Solutions to the improving/developing this service

- increase human resources for the service to be successful
- provide reliable mobile devices to all remote health centres and verify its signal coverage
- training required for doctors
- training required for system operators.
- Accessibility through language or the use of a specialist application

Solutions to the improving accessibility (digital divide)

- Provision of devices, addressing language differences, training for staff/health care workers

Solutions to the problem of the regulation of this medical service

- governments approval (by establishing policies) of this medical delivery service as a benefit for remote health care centers
- traffic controllers' awareness of medical delivery drones flight path.
- identification of strategic medical delivery drones bases around the country and other vicinity countries

Examiners should reward suitable responses that are not included in this mark scheme. Before awarding marks, please check with team leader.

Please see the criterion level descriptors on page 15

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	One feasible solution to at least one problem is proposed and described. No evaluative comment is offered. Material is either copied directly from the article or implicit references are made to it.
3–5	One appropriate solution to at least one problem is proposed and partially evaluated. The response contains explicit references to information in the article that are partially developed. There is some use of appropriate ITGS terminology.
6–8	One appropriate solution to at least one problem is proposed and fully evaluated, addressing both its strengths and potential weaknesses. Areas for future development may also be identified. Explicit, fully developed references to the information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.