Markscheme

November 2015

Information technology in a global society

Higher level and standard level

Paper 2

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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: Health

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

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

[1]: for identification of the concern (which does not have to be explicitly named).

*[2]: there needs to be an explicit description of the impact/result/consequences/
effect/outcome on the citizens, medical staff and Government Ministry of Health.*

Social/ethical concerns may include the following:
- reliability of the EMR system – if the EMR system is down, then the medical
  staff do not have access to the medical information to treat the patient
- reliability of the IT infrastructure – if the network is down, health centres will
  not have access to the EMR data
- digital divide and equality of access by medical staff – in rural areas slow
  internet connection can hinder access
- people and machines – citizens may not have the abilities to use
  computer-based technologies
- security concerns regarding the secure storage or transmission of medical
  information about patients - could lead to embarrassing medical info being
  spread or information could be tampered with and lead to medical mistakes
- authenticity concerns - low level authentication *eg* username and password
  may be easily guessed allowing for unauthorized access (*eg* insurance
  companies, reporters looking for private info, future employers, other citizens
  giving them access to personal medical information that could be used
  "against them"
- privacy concerns - private medical information could be made available to
  parties without citizens knowing for purposes not intended *eg* health insurance
  companies being given access to review health insurance policies; other
  family members may gain access to private healthcare that they prefer their
  families not to know about
- lack of policies on who has access, how they access, when they access and
  for what purpose could lead to the concerns above
- lack of policies about updating the medical information - follow on to
  previous point
- integrity - loss of integrity of data due to poor security/authentication -
  could lead to medical staff not being able to rely on the medical information
  when treating patients.

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

   [1]: Who - identification of the stakeholder.

   *[2]: **What** are they doing with the IT system and **Where** in the IT system (technical part).*

   Primary stakeholders may include the following:
   - citizens of Brunei
   - medical staff (*ie* doctors, nurses, medical technicians)
   - government Ministry of Health (MOH).

   Relationship of primary stakeholder to IT System:
   - citizens have their health data stored on the EMR system (must make reference to a medical database or the EMR system - by name "EMR database" or "the database" or "the database system". Referring to "a database" is not enough as it is too general
   - medical staff use the EMR to access patient medical records to help treat patients
   - Government Ministry of Health – implement the system and monitor it.

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: Brunei's electronic medical record (EMR) database

Three major steps that are in the article:
- the registration of patient details
- the access to the data stored in the EMR database (by Medical staff/nurses)
- the use of the EMR system.

[1]: the student may show some understanding of the process but not in a step-by-step approach – using the information in the article and possibly some steps missing.

*[2]: the student is able to provide a logical step-by-step account using the information in the article but lacks some details. Must contain at least **two** major steps from the article - registration, access/storage, and use. No developments presented. Best fit if contains developments/information beyond the article but not in step-by-step.*

*[3]: the student is able to provide a step-by-step account which may be detailed. It must contain at least **two** technical developments and **two** of the major steps (registration, access/storage and use).*

*[4]: at least **four** technical developments and **two** or more of the major steps (registration, access/storage and use).*

Answers provided in the article include the following:

Registration:
- Brunei citizens complete digital forms and scan a copy of their identity cards/passports using computers at the hospital or health centre (line 13)
- installing the EMR App (line 15)
- proof of identification is made by taking a photograph of the citizens ID card with the smart device and uploading this with the registration (line 16)
- access
- once the registration is approved, the public can retrieve their BN number, a reference number to identify patient's records (line18).

Use of EMR
- MOH use of database for a variety of purposes to access information and analyse trends (line 24)
- use to deal with nationwide epidemics *eg* H1N1 (line 23).

Answers with additional information to that in the article may include the following:

Registration:
- BN number is the Primary Key
- all records are stored in the EMR system on a central server
- setup patient record in EMR database
- describe fields in EMR database record for patient.

Access:
- hospital staff may use a mobile device or PC computer and a web based interface or EMR client to access the central server of records
- internet network is used to connect health centres and hospitals to servers
- secure connections will be established between the client and server
- hospital staff will log in to the system *eg* use of username and password
- hospital staff will be given different access rights depending on their role in the hospital
- hospital staff will access the patient records by keying in the BN number to search the database to the matching record
- the record will be displayed on the screen of the device.

Use of EMR:
- records will be updated each visit
- MOH staff will analyse EMR records to identify outbreaks of diseases
- doctors will use EMR records to view medical history and prescribed drugs
- electronic documents *eg* scans will be attached to the EMR records.

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

Explaining the link between the concern and specific parts, or whole, of the IT system means the student must include how and why the concern has arisen from the use of the IT system. The naming of the concern identified in Criterion A may be implicit.

Q2(b) clearly asks for a link to Q1(a), but the link only needs to be generic – eg for a specific security concern described in Q1(a), then in Q2(b) the student can explain a security weaknesses without reference to the specific concern in Q1(a). If the concern addressed in Q2(b) is completely different from that in Q1(a) a link cannot be made and hence [0].

Q2(b) can also be related back to Q1(b) where the who and what and where of the IT system usage are described.

[1]: if the student identifies the relationship between the concern and the IT system. This may be a repeat, or rewording, of the response to Q1(a) or lack of detail for the how and why.

[2]: how and why the concern can happen must be described: eg privacy: responses need to specify how (technical) the data can be accessed (similar to some of the steps for Q2(a)) and why it has been allowed to be accessed (eg lack of privacy settings – weakness with the technical).

Answers may include the following:

Reliability of the EMR system would be a concern if:
- the EMR system is down, then the nurses do not have access to the medical information to treat the patient (how) *ie* loss of electric power, software bug, hardware faulty (why).

Reliability of the IT infrastructure would be a concern if:
- the network is down, health centres will not have access to the EMR data (how) *ie* loss of internet connectivity to certain areas due to power cuts, problems with internet hardware provided by the Internet Service Provider, would prevent the health centres from accessing the central server and the EMR system (why).

Digital divide and equality of access by medical staff would be a concern if:
- in rural areas slow internet connection can hinder access – in cities Fibre to the Home (FTTH) will allow a faster internet connection and therefore improved performance of the EMR system, compared to rural areas which may have slower broadband or 3G internet connectivity – this could lead to slower response times by clinic staff when treating patients (how)
- Governments/ISPs not investing in rural areas, inadequate number of cell towers for mobile broadband (why).

People and machines would be a concern if:
- citizens may not have the abilities to use computer-based technologies – citizens who are not confident using computer based technologies may find it harder to register for the EMR system and will not be able to take advantage of logging in or accessing their records (how); citizens may not have digital literacy skills (why).

Security concerns:
- when transmitting data - access from within the hospital or from outside the hospital to where the EMR server is stored may not have adequate security measures in place, allowing unauthorized users to access and modify medical data (how); use of insecure or poorly secure wifi to register or access the EMR *eg* public hotspots, home wifi using default or no password; use of wifi as opposed to a wired connection in the hospital
- when storing the medical data on the EMR - access to the EMR may not have adequate security settings allowing unauthorised people to access the database *eg* hacking the EMR database, accessing confidential aspects of the EMR when not necessary *eg* admin staff (how) *eg* lack of firewall, easy to guess passwords by medical staff, poorly set access rights.

Authenticity concerns -
- on level authentication *eg* username and password may be easily guessed allowing for unauthorized access (how); weak passwords, malware obtaining log on details at keystrokes (why).

Privacy concerns -
- private medical information could be made available to parties without citizens knowing for purposes not intended, *eg* other stakeholders being granted access by the administrators or guessing log on details in order to access the medical records (how); lack of policies, easy to guess log on details (why).

Policy concerns -
- lack of policies on who has access, how they access, when they access and for what purpose could lead to the concerns above (how); Administrators not educated in the social and ethical issues of record keeping (why).

Integrity concerns -
- poor security and authentication when using the IT system could lead to loss of integrity of the medical information *eg* when an admin worker has access to the medical diagnosis field and updates it deliberately or by accident (how); incorrect access right settings; rogue employee; unauthorized access due to poor security settings *eg* weak firewall, no encryption.

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 the 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.

Impact = result/consequence/effect/outcome on stakeholder

*There are a number of impacts that can be compared and critically analysed.
Given the time constraints not all are needed.*

*At least two stakeholders are required for entrance into the top markband – usually the
citizens medical staff and one other eg the Government, software developer.*

[1]: one or two impacts identified.

[2]: more than two impacts described of either type – positive or negative.

*[3]: analysis by structure – division into groups eg positive/negatives and/or various
stakeholders.*

*[4]: at least **two** negative and **one** positive impact for at least **two** stakeholders in order
to provide a balanced analysis in the top markband. Only one stakeholder analyzed or
unbalanced analysis maximum of [4], eg the impacts on the citizens only or negative
impacts only.*

*[5-6]: must include linking analytical connections (between positive/negatives, various
stakeholders, various issues) and added evaluative comments about the implications
for stakeholders. Significant analytical connections and evaluation comments required
- clear evidence of additional thinking beyond descriptions and structure.*

*[7–8]: a conclusion backed by direct reference to the impacts described is needed.
The evaluation should focus on the **overall** impact on all the stakeholders mentioned
discussing the **balance** between the positive and negative impacts.
 .*

Social/ethical issue	Positive impact on the relevant stakeholder	Negative impact on the relevant stakeholder
Reliability of the EMR system	• less vulnerability to loss of the patient records (paper records can easily be damaged by fire/floods or lost) but EMR are backed up, can be accessed simultaneously from more than one location *eg* clinic – this leads to better diagnosis by medical staff; more efficient serving of patients as records can be accessed quickly; saving of time by both patient and medical staff; enables doctors, nurses and other allied health professionals to pull together a patient's information and medical history under one record.	• if the EMR system is down, medical staff cannot access the records nor the backups in a timely manner – this could lead to the inability to give correct diagnosis or follow up care by doctors/nurses to the patients.
Reliability of the IT infrastructure	• access to central records in rural areas can help medical staff treat patients who are not normally resident in that area	• cost to the government – setting up of faster internet connections – country wide is expensive • need to have strong IT support systems and professional IT personnel who can help – this could lead to an increase in costs for the Ministry of Health to recruit technical staff and the Government to ensure enough IT support professionals are trained up and are available in the workplace
Digital divide and equality of access by medical staff	• medical staff can see the newly-implemented standards which are disseminated through the records and act on them • in case of a nationwide alert, the EMR system be accessed for relevant information and further action be taken • the Ministry of Health can use the EMR system to analyze trends and provide for future health services.	• poor internet connectivity in rural areas – medical staff may give slower service to Brunei citizens needing medical assistance – longer waiting times by patients.

People and machines – citizens may not have the abilities to use computer-based technologies	• make it easier for patients when dealing with hospitals or health centres and obtaining patient's medical history and test results will be made easier and quicker.	• Citizens will have difficulties registering themselves in the Brunei EMR – which could lead to slower service when visiting a hospital or health centre in an emergency (patient will not be seen by doctor unless registered with the system).
Medical professionals require training to use the EMR system	• medical staff – have opportunities to use up to date technologies – which assists in their own professional development and ability to change jobs or be promoted.	• medical training is costly to the Ministry of Health – courses need to be paid for and staff covered while undergoing training • some medical staff may dislike using technologies and despite training opportunities – still not be efficient in using the system • human error in editing the EMR – could lead to medical history not being accurate.
Security		• poor security settings could lead to citizens being able to access other citizens medical information, embarrassing health conditions are exposed; health insurance companies may gain access and review insurance policies; future employers may not employ citizens if they know their full medical history • medical staff may not have access to accurate medical data if there is a chance of it being tampered with • hospital administrators may have to spend more money on providing IT hardware/software and staff to keep the EMR secure; may be held responsible for breaches in security • staff/patients may need educating on keeping log on details secure and private.

Authentication		• authenticity concerns -may lead to privacy concerns for citizens (see below) info • may lead to loss of integrity of data - medical professionals may not be able to rely on the data when giving medical care
Privacy		• citizens may have higher health insurance if health insurance companies are given access to EMR; • citizens may face discrimination if their friends, neighbours and families find out about their medical conditions; may be denied jobs based on their medical history
Policies		• lack of policies on who has access, how they access, when they access and for what purpose could lead to Hospitals being sued • lack of trust in the Hospitals and how they handle medical data • could cause serious cases of medical malpractice - poor reputation • may be costly to employ people to help write policies.

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**.

   [1]: solution is identified.

   [2]: solution is described (what, who, where) and the link to article may be implicit, which could be a general description eg general policy description similar to that found in a textbook.

   [3]: the solution is applied to the problem directly and not generally – how and why it solves the problem (first positive evaluation).
   The solution must be feasible and can be applied to the problem, even if not good "quality".

   [4–5]: at least one more positive evaluation and at least one negative evaluation is required. Best fit if description is limited.

   [6]: fully evaluated strengths and weaknesses requires a balance of at least two positive and negative evaluations.

   [7–8]: concluding paragraph directly referencing the evaluations. Students may propose future developments in response to the evaluations, such as solution/s to the negative evaluations, as part of the conclusion – best fit applies if included instead of discussion of evaluations.

   Best fit also applies if a student has not fully described the solution or provided the minimum four evaluations.

Answers may include the following:

Problem	Solutions
Reliability of the EMR system	• backup generators • on site – technical support staff to regularly test and run diagnostics on the EMR system software • Back Up Recovery Plan • use of Mirror Servers to automatically switch-over in the event of hardware.
Reliability of the IT infrastructure	• government to invest in back up infrastructure *eg* more than one internet connection to each hospital/clinic.
Digital divide and equality of access by medical staff	• government invest in high speed internet connectivity in all areas of the country.
People and machines – citizens may not have the abilities to use computer-based technologies	• instructions for citizens in order to register themselves on the EMR system • drop in centres to provide training on how to use the EMR system.
Medical professionals not efficient in how to use the EMR system	• training in the use of the EMR.

*If the evaluation does not provide any additional information to that in the article,
the candidate will be awarded a maximum of [2].*

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.