As suggested by Schwalbe, our team conducted a brainstorm to identify the risks and issues that could be present in the solution for this project. Schwalbe lists several knowledge areas in the risks of an IT project, but we focused on areas that applied to implementation of the solution specifically (2015).

**Costs:**

Budget is a major issue for this project, after speaking with Gillian Frankcom-Burgess - a Mathex judge and one of the event organisers, it was clarified that AMA would not be able to provide any financial assistance for the system.  
The markers and scorers at the Mathex competition are all volunteers, and the audience members and schools are not charged for their attendance. AMA has a budget of $0.  
  
There is no free way to implement this system due to the following factors; all potential solutions require purchases of either hardware of software in order to operate, setting up the system on the day requires labour time, maintenance of the system requires labour time, hardware or software failure will incur fees to replace them. Technically the development time also costs AUT money, and has already incurred costs within our team.

**Possible Solutions:**

The system would require a sponsor to be completed, whether the client is willing to take this on, or AUT or some other unknown stakeholder.

Future costs could be covered by advertising within the system, however this may make the system less attractive and inconvenient to users.

**Users:**

The users of this system potentially include parents, markers and scorers. Information from Frankcom-Burgess gave us insight into who the markers and scorers are. They are volunteers, mostly consisting of teachers and are often older and unlikely to have much technical knowledge, she says “many [markers] are a lot older than [the developers (in our 20s)] and many of them do not have a smartphone” (2017).

The Mathex competition has been running since approximately 1980, and has not changed much since the Frankcom-Burgess first became involved 15 years ago. The pen and paper system is tried and true for the markers and scorers, and changing this system is unlikely to be received well initially.

On top of this, the markers and scorers are not picked early, and are unknown until the date of the competition. Frankcom-Burgess states “I don’t know who [the markers] are going to be before they arrive” (2017). Training is brief because it is simple, there would not be any time to teach these users how to use the system without error.

**Possible Solutions:**

There are some alternative ways to implement the system that may aid in this problem. This is based around the availability of the system per user, and we explore this further in the following issues.

Rather than asking each marker to input the score for a team, we can ask the scorers to do this, and ask for compliance from AMA’s end to organise who these scorers will be. A scorer is usually responsible for collecting the scores from multiple markers and so they could update the system.

Otherwise, an employed or volunteer single scorer who is well versed with the system could gain permission to attend the event and gather scores to update the leaderboards.

**Effect on event sentiment:**

Audience members currently watch the competitors race across the venue to run their scores. While we are yet to see the competition unfold before our eyes, videos and descriptions of the event would infer it is an exciting event to watch.  
In a situation where a system that is available on the spectators personal devices is implemented, rather than watching the competition before them, parents and other audience members will be spending time looking at their phones, missing out on the action.  
Although the innate problem is the confusion of who is winning the competition, the thrill and mystery of this will be eliminated by this solution’s implementation. Therefore, it may not necessarily be beneficial to introduce.

**Possible Solutions:**

While the client initially suggested allowing spectators to have the leaderboards on their personal devices, it is possible to set up a projector or screen in the event venue instead. This way the spectators are still seeing over the main event, much like at any sports or music event, the screens are there to compliment, rather than replace the atmosphere.

**Distraction to competitors:**

This refers directly to the solution supplied above. A large screen in the venue is may cause distraction for the competitors. Where normally they would be focused on the math questions that they are given, there would now be a large leaderboard in full view for them. When students have their performance monitored and compared to other groups, this may impact their performance. Ark describes this issue, with the criticism that it may be a detriment to students that are struggling and favours the students who are excelling (2016).

The competitors are kids, most younger than 13, the competition is supposed to be a fun experience rather than a source of stress.

**Possible Solutions:**

Instead of installing a screen, only allow the spectators see the scores so that there is no longer a distraction for the competitors. We are aware that this solution directly contradicts the previous solution, this is a major dilemma and a significant contributing factor to the project’s infeasibility.

**Suboptimal infrastructure available:**

As outlined in the study in the section “Existing Equipment” in Venue Infrastructure, there is little available infrastructure for a system to be installed. Hardware would need to be supplied to boost the signal from one, or potentially two access points. We do not believe the network here is aimed at supplying sustained connectivity to 500 or more concurrent users.

At this time, we are not sure whether there is suitable space for a local network or any hardware to be set up, further inspection of the venue is required here.

**Possible Solutions:**  
We can put in a request for the venue to upgrade their infrastructure and hope for the best in that regard.

Alternatively, we can ask that spectators use their own data to access the scoreboard, there may be issues with service providers in this respect, but it takes responsibility away from the venue or AMA to maintain a connection for them. The WiFi will exclusively be for the scorers or markers using the scoreboard solution.

Having a local network set up also solves this issue, however this hardware will be very costly.

**Health & Safety:**

When introducing any hardware into a venue at any event, there are always health and safety concerns. All electrical equipment introduces a potential fire hazard, more details about this are outlined in the Disaster Management section of the hardware requirements.

Affixing a screen to anywhere in the stadium also presents a risk, it needs to be stable and not fall and potentially harm anyone attending the event.

**Possible Solutions:**

Options here are to create a Disaster Management plan and gain approval from the venue when the system is ready. The risk here being that all equipment is purchased and is then deemed unsafe.

Using a cloud solution bypasses many of these issues, as the only hardware required is personal devices.

**System Failure:**

Regardless of the solution selected, there is always a risk of system failure. Hardware systems pose more of a threat because they require hands-on maintenance from the hardware owners, ensuring they are updated, backed-up, secure, cleaned and kept cool and dry (eBay, 2016). Even then, hardware has a life-expectancy and will need to be replaced or upgraded to avoid failure due to wear and tear, and in doing so this can also be the root cause of an outage (Zhu, Mauro, & Pramanick, 2003).  
With a software solution, bugs may arise, it is the developers’ responsibility to handle these kinds of errors. However, in cases where the system has a third-party host, it relies on their maintenance to keep it up and running. Occasionally these services go down, or stop offering their services because they grow too complex, they become obsolete, or maintenance becomes too difficult (Kajko-Mattsson, 2001 so the developer will need to have a back-up plan ready for these situations.  
  
**Possible Solutions:**

Careful maintenance of hardware will be required to avoid system failure, this will come at a cost to whomever the hardware owner is.  
Software failure can be prevented with scheduled testing and by having a backup server provider in case the chosen one becomes unavailable. Selecting a good server provider helps avoid this issue too, and any concerns can be resolved by contacting the provider directly.

**Marketability:**

As stated previously, the competition has already been running for numerous years, using the same pen and paper scoring system. This works well for the markers, scorers and judge, and there is no need for them to replace it or introduce a system that makes the process more complex.

At this point we have little evidence to show that implementing the system is a necessity to the spectators. To our understanding, the members of the audience almost exclusively are parents of the competitors, whom we infer are there to support their children, rather than track which teams are in the lead. But we understand that it would still be a nice thing to know how the competition is unfolding.  
  
Frankcom-Burgess stated that while she felt the system was not entirely necessary, a weak point in the system is knowing when a team is about to win and getting an accurate timing on when that team won. Even with this in consideration, we would be hard-pressed to convince AMA to implement the system “The competition is low-key” and “It’s just meant for us” are among statements from Frankcom-Burgess (2017).  
  
**Possible Solutions:**

The scoreboard was suggested with the spectators in mind, so these are the people we need to get in touch with to ascertain whether this is a system they would like to see implemented. Seeing as the next Mathex competition is not too far away, we could hand out surveys at the end to parents, or interview them and ask for their opinion and give a short description of what they could see at the next Mathex competition. If they support it, it may convince the organisers to work with us to reach a realistic solution.

**References:**

Schwalbe, K. (2014). *Information technology project management*. Cengage Learning.

Kajko-Mattsson, M. (2001). Can we learn anything from hardware preventive maintenance?. *Engineering of Complex Computer Systems, 2001. Proceedings. Seventh IEEE International Conference on* (pp. 106-111). IEEE.

Zhu, J., Mauro, J., & Pramanick, I. (2003, June). Robustness benchmarking for hardware maintenance events. In *Dependable Systems and Networks, 2003. Proceedings. 2003 International Conference on* (pp. 115-122). IEEE.  
  
eBay (2016). *How to Properly Maintain a Server (and Minimize Downtime!)*. Retrieved August 4, 2017, from http://www.ebay.com/gds/How-to-Properly-Maintain-a-Server-and-Minimize-Downtime-/10000000177629547/g.html

Ark, T. V. (2016). *To Leaderboard or Not: The Art of Motivating and Monitoring* Performance. Retrieved from http://www.gettingsmart.com/2016/03/to-leaderboard-or-not-the-art-of-motivating-and-monitoring-performance/