

T452-24B EMA – PROCESS REVIEW

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Part a

In TMA01, I identified all the UK-SPEC Incorporated Engineer competencies as relevant to T452 project work, except C3 on managing teams. My most important competence was B3, “Implement design solutions for equipment and processes and contribute to their evaluation” (Engineering Council, 2020), due to lack of any similar previous experience.

I effectively developed this competence by designing, building and testing a working device that largely achieved its aim. I analysed the needs and resources beforehand, and I solved the problems as they appeared and implemented corrections (such as deriving a calibration formula for the inaccurate FFT outputs). I made sure that safety and security aspects were considered by producing a risk assessment table and following safe practices. I also considered the usability aspects with an effective user interface and thought about ergonomics of the device. I analysed the project results and proposed recommendations for further improvements.

Other important UK-SPEC competencies that I developed were A1 through deep and thorough literature research, A2 through practical iterative prototyping and investigating the problems and their background, B1 through researching and selecting the most appropriate applications, C1 and C2 through creating and following a detailed project plan, D1 and D2 through written correspondence and submitting written technical work, E2 by carrying out and complying with a risk assessment, E3 by including the affordability and simplicity considerations for the benefit of wider society, and E4 through keeping an extensive project log.

Overall, the project was therefore an excellent opportunity to learn how to systematically approach and successfully carry out complex design and development tasks, taking into account a wide variety of aspects. It was of great importance as it significantly increased my engineering skills bringing them more closely in line with the requirements of the UK-SPEC and consolidating all the knowledge acquired during my studies.

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Part b

- i. Firstly, it was persistently difficult to obtain accurate frequency readings from the chosen Arduino FFT library. Secondly, the metalworking workshop hired to solve the torque transfer to the piano, provided a weak solution that broke immediately.
- ii. The FFT problem, I think, was caused by the arguably dubious assumption that any standard FFT library should always work properly. For the torque transmission I made the mistake of relying solely on the judgment of the workshop to ensure the necessary component strength.
- iii. For the FFT I successfully applied a calibration formula and a band-pass filter to improve the accuracy and usability of the readings. For the mechanical part I created my own solution based on proper assessment of strength needs.
- iv. In both cases I generally learned that less should be assumed and trusted, and more should be explored and analysed beforehand when deciding on what resources to use.

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Part c

1. If restarting, I would ensure access to a traditional piano close to where I live in Luxembourg. Here I only had an electronic piano, so I intended to use the piano of my mother-in-law in Latvia during several weeks in the summer. This seriously limited the testing of the device. A real piano in Luxembourg would have helped me to discover certain issues (such as difficulties with frequency detection or motor control adjustments) much sooner.
2. I would explore more FFT libraries available for ESP32 on Arduino in the early project stages. Certain limitations of the chosen FFT library made some developments more difficult, so more time with FFT research would have provided me with more opportunities to either choose a better library or create a custom-made solution better adapted to the specific purpose of the project.
3. I would have limited the project scope to only 2 octaves of single strings right from the start instead of aiming at full tuning. It was possible to determine the potential difficulties much earlier which could have helped me to improve the device to a level where it could tune all project notes to within the set tolerances or even better.

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REFERENCE

Engineering Council (2020) 'The UK Standard for Professional Engineering Competence and Commitment (UK-SPEC), Fourth edition'. Available at:
<https://www.engc.org.uk/media/4338/uk-spec-v14-updated-hierarchy-and-rfr-june-2023.pdf>
(Accessed: 6 September 2024).

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