Summary Note from snap-shot consultations with FTS stakeholder

Dr Ruth Graham, 10th October 2021

CONTEXT: In the final three months before the Technology Education of the Future (FTS) project submits its final report to the Norwegian University of Science and Technology (NTNU), a snap-shot external review was commissioned to assess how the FTS is perceived by project stakeholders, and to highlight any strengths and weaknesses apparent. This confidential Summary Note highlights key findings from these consultations. Two points should be noted about this rapid snap-shot review.

Firstly, it draws on interviews with 13 individuals (university leaders, professors, and students) held on 6th and 7th October 2021. The review does not draw on any other information or evidence; it relies solely on the interview data and the consultant's wider experience in engineering education reform. Anonymised quotes from interviewees are used throughout this Summary Note to illustrate the views expressed.

Secondly, the Summary Note has been written specifically for the audience of NTNU staff. It therefore does not provide a description of the FTS aims, focus or activities, and does not offer explanatory notes for acronyms used, such as the 'FUS committee'.

Introduction

Interviewee feedback made clear that the FTS is a thoughtfully-designed and evidence-based project to enable far-reaching educational reform together with systemic change to the institutional processes and infrastructure that enable excellence in teaching and learning. Interview outcomes also point to a strong level of support for the FTS aims and vision from across all levels of the university. Particular support was expressed for two aspects of the FTS reform:

- the commitment to integrate sustainability into the curriculum, and ensure that students are able to contextualise their learning by applying it to real societal and industrial challenges through team-based active and collaborative learning;
- the switch from course-centred to program-centred educational design, with greater integration and coherence between the components of each undergraduate program, allowing students to build a community across their programs and connectivity across their learning.

One of the most striking elements of the FTS plan for change is its scale and ambition. The FTS is proposing a profound change that will impact all levels and divisions of the university. Interview feedback suggests that a major factor underpinning the scale of the FTS plan is the fact that the NTNU technology education (as a whole, prior to the 2016 merger) has not undergone any systemic changes for an extended period. Most interviewees noted that, while examples of good practice undoubtedly exist, the NTNU education as a whole was "*old fashioned in how we do things*" and "*in drastic need of modernisation*".

For this reason, the FTS reform appears to consolidate what might otherwise have been a series of discrete educational reforms (such as the systemic integration of active learning, the switch to an outcomes-based educational design, or change to pedagogical competence profiles/training) in a single step. Indeed, at many institutions at the forefront of engineering education worldwide, changes similar

to the FTS have been delivered as part of several discrete change efforts rolled out over the past two or three decades.

One particular component appears to have been a substantial – and critically important – part of the FTS development: the definition of competency profiles and the efforts to align them with the national learning outcomes. The existing national guidelines were understood to have framed educational design around knowledge-based learning outcomes, with students' skills and attitudes almost added "*as an afterthought*". The development of new NTNU competency profiles was therefore noted to be critical to embedding a more holistic set of learning goals into the NTNU education.

Building the evidence and laying the groundwork for each of these steps – including the design of the competency profiles – has been essential to the development of the FTS, but has taken time. At the same time, the COVID-19 pandemic has clearly imposed considerable disruption and delayed some FTS elements. This time may have come at the cost of operational planning beyond January 2022.

Overall, the interview feedback points to three inter-related issues facing the FTS reform that may impact its successful roll-out, as outlined below:

1. **the ways in which FTS (and its likely impact on pedagogical practice) are communicated**
2. **the governance model for driving institution-wide change post January 2022**
3. **opportunities for grassroots engagement and cross-university collaboration**

Each of these three issues is outlined in the sections that follow. Of these, the single biggest risk facing the successful delivery of the FTS vision appears to be the second: the governance and ownership of the change effort post-January 2022, when the FTS committee is due to step down, and how this impacts the momentum and capacity for educational change across NTNU.

It should be noted that a number of contextual factors are also likely to work against the momentum for the FTS change. The reform is being implemented across an institution that is large, geographically dispersed, culturally diverse, and where individual professors appear to hold considerable autonomy. In addition, the fact that NTNU is such a well-established university – that has educated around 90% of the country's engineers – was understood to have created a "*conservative attitude*" and a complacency with respect to the need for change. COVID-19 is also likely to have a major impact on capacity for reform, with many academics feeling overworked and exhausted after 18 months of operating in emergency teaching conditions. Indeed, interviewees noted that the impact of COVID-19, together with the fact that NTNU is preparing for a major campus development, is likely to mean that "*FTS is not the main topic at the lunch table*" for many academics. Some interviewees went on to note, however, that COVID-19 emergency teaching had demonstrated to many the capacity of NTNU academics to enable fundamental and rapid educational reform: "*80% of the teaching was shifted to digital teaching within two weeks… that shows the potential for change*".

1. The ways in which the FTS is communicated

Interview feedback suggests that the FTS reform would benefit from a sharpening and refocusing of its communications around the FTS vision and what this change will mean, in practice, for the design of NTNU programs and the pedagogies adopted by NTNU academics.

Much of the communication around the FTS appears to focus on the outcomes of the new education rather than the approach. As discussed in the introduction, significant time and expertise has been

dedicated to defining 'competency profiles' for FTS. A number of interviewees noted how these profiles, and the way they were constructed, had been a "*revelation*" that "*opened my eyes*" to new ways of thinking about teaching. For this reason, perhaps, competency profiles have featured strongly in the communication of the FTS. Indeed, when asked to describe FTS, most interviewees framed their response around key FTS intended learning outcomes. When asked to describe what change might look like in practice, however, the descriptions varied widely with few uniting themes apparent.

While framing FTS around learning outcomes in communication materials has undoubtedly precipitated a positive shift in thinking amongst many about best practice in educational design for the future, this may have come at the cost of understanding what such an education might look like in practice. This issue appears to have been compounded by the length of the FTS reports, with around half of interviewees stating explicitly that they had not had the time to read any of these materials.

Interviewee feedback points to two priorities to improve the FTS communication.

Firstly, the communication of FTS should be simple, clear and concise. If the messaging around such a wide-ranging and diffuse project is poorly understood, two particular risks emerge. One is that some Faculties might adopt a version of FTS that does not align with the intended vision, and take forward educational reform in a very different direction. Another risk is that some Faculties and/or academics might claim that they are already addressing key components of FTS in their courses/programs and therefore did not need to engage in the change effort. A priority, therefore, appears to be the development of a short and accessible 'elevator pitch' that outlines the essential elements of the FTS change that can be communicated across all levels of the university.

Secondly, dedicated information should be provided on what the FTS changes might look like in practice, in both programmatic and pedagogical design. Indeed, interviewees made clear that while stakeholder support for the FTS vision was strong, a major barrier to change concerned its implementation in practice. In the words of one interviewee, "*the goals and the objectives are well understood, the big question is 'how' always. At all levels we are struggling with this: how should [academics] develop their teaching*?". Key practical questions around FTS implementation that were raised repeatedly by interviewees included:

- before the new campus redevelopment rolls out in the coming decade, will all NTNU academics have access to the sort of flexible, flat floored learning spaces needed to deliver the types of active and collaborative learning called for by the FTS plans?
- what assessment approaches align with the FTS learning goals and how might they be best embedded into courses?
- how can academics satisfy the seemingly onerous national restrictions – such as the need to integrate external assessment for all graded assignments or the requirement that written course information is legally binding – while seeking to experiment with new educational approaches and iteratively improve pedagogical practice?
- how can academics determine what "*content to take out of our courses*" when enabling the FTS reforms while still maintaining the rigour and integrity of their courses?

It should be noted that a number of resources already under development at NTNU are likely to help to address some of the above questions. For example, the FTS sub-group for non-engineering bachelor programs is currently establishing a resource bank that showcases examples of how different FTS competencies have been applied in practice in NTNU courses and programs.

2. The governance model for educational reform post January 2022

Interview feedback suggested that, based on a recommendation from the university Deans, the FTS project committee will be disbanded in January 2022, with responsibility for the FTS implementation devolved to Faculties, with oversight by FUS and FUI. Such an approach will undoubtedly empower Faculties to design and deliver a bespoke educational reform that aligns with their culture, priorities and areas of expertise. It will also provide an important mechanism to advance engagement by the 'grassroots' and foster 'bottom-up' ideas. However, disbanding the central agency devoted to FTS at this relatively early stage in the definition and roll-out of the change effort appears to pose significant risk to the project's successful implementation. In particular, a number of key questions appear to remain unanswered about the ongoing governance and operational management of the change effort, as well as its plan for implementation. So, for example, beyond January 2022:

- who 'owns' the institution-wide FTS reform initiative and will be ultimate responsible for its successful delivery across NTNU?
- what will prevent some Faculty Deans from deciding that, given the massive disruption of COVID-19 and the upcoming campus merger, FTS is simply not a priority to them at this time?
- what will the NTNU-wide FTS reform effort be called after January 2022, given that the remit of FTS was only to develop proposals for change?
- how will the lessons learnt from the pilot projects be fed into future planned FTS changes?
- will the Nordic reference group (who have clearly played an important role in informing the FTS plans to date) play a role in reviewing and informing the change effort in the future and (if so) where is their point of contact at NTNU?
- who will help to broker connections and partnerships between individual academics from across NTNU with a particular interest in specific FTS goals?
- who will review the sum of all NTNU-wide efforts to meet the FTS goals and convene resources to fill any gaps that are apparent?
- who will answer academics' questions about the FTS evidence-base, scope and goals if they cannot find answers within their own Faculty?
- who can individual academics turn to for ongoing support/resources to drive change in their own courses/programs if their Dean or program director is not supportive of reform?

While driving the reform effort from a Faculty level is a sound approach, the establishment of a complimentary institution-wide oversight and support board appears to be vital to the successful delivery of the FTS goals. Indeed, interviewee feedback suggested that, at present, while Faculty Deans and the Rector had ratified the FTS proposals, none had entered into a binding agreement. For some, this left open the possibility that the FTS reforms would be "*optional*" and based only on the commitment of individual Deans or program leaders. Without an ongoing oversight of the university-wide changes, it may be difficult to maintain the momentum for change and hold Faculties to account. While FUS may play such a role, it has a significant number of competing responsibilities, and its remit only extends across the NTNU Master programs in technology and engineering.

There is also an argument for the allocation of dedicated and centralised funds to support the FTS change effort across NTNU, above and beyond the budgets held by Faculties. The development of new, experimental courses and programs takes considerable time and resources, including (importantly) buying out the time of the academics leading the change effort. NTNU may struggle to establish new

flag-ship courses – especially ones that span Faculties – without a new stream of dedicated funding. In this regard, it is interesting to compare the development of the new NTNU Statistics course with the new Mathematics first-year course[1] in UCL Engineering. Both were developed during the same timeframe, for a similar student cohort size (around 1200), taking a very similar blended, experiential approach to introductory mathematics. The teaching team for the NTNU Statistics course comprised 14 individuals, including four academics, two teaching assistants and eight student assistants (each working 100 hours). In contrast, the teaching team for the UCL Mathematics course comprised around 60 individuals, including a course lead and educational designer (who each engaged almost full time for the duration of the course development), 17 academics and 40 post-graduate teaching assistants.

3. Opportunities for engaging and connecting the 'grassroots'

Critical to the successful delivery of any educational change is the widespread engagement of the academics charged with its delivery. The FTS appears to have already brokered new connectivity between disparate corners of NTNU that historically have had little or no interaction. Many interviewees noted that awareness of the FTS amongst academics has also improved significantly since early September 2021 when a face-to-face seminar was held to showcase advances made in the FTS pilot projects. It was estimated to 50–60 academics attended this seminar, in addition to the academics already involved in FTS pilots and workshops. Nevertheless, interviewees pointed to the need to advance engagement and connectivity across the academic community.

In particular, interviewee feedback pointed to the need for a new forum for academics from across the university to come together and share ideas and hold exploratory discussions around new opportunities for cross-campus collaboration and team-teaching. One impact of COVID-19 has been to styme the development of an educational community of practice and the socialisation of the FTS concept. As NTNU transitions out of emergency teaching restrictions, it will be important that the university takes this opportunity to broker new avenues for nurturing cross-institutional community and collaboration around educational change.

In addition to creating a forum for academics, NTNU might also consider raising awareness of the project amongst the broader student community. Some interviews suggested that the NTNU culture of involving students in all decision-making processes would almost eliminate the risk of student dissatisfaction with the implementation of the FTS reforms. However, the experience of many new engineering education programs that are the product of systemic reform (rather than new programs that are developed from a blank slate) is of some level of student dissatisfaction in the early months and years. Student reactions are often particularly extreme when they are first asked to tackle ill-defined problems in complex 'real world' authentic contexts as part of a mandatory (rather than optional) course. Early engagement across the student community about the rationale for integrating such experiences (and the benefits they will likely yield for their employability on graduation) is likely to reduce the risk of adverse student reactions to the introduction of new FTS courses and programs.

While representing potential barriers to the successful roll-out of the FTS, all challenges listed are in the purview of NTNU. All, too, can be addressed by relatively small changes to the governance, internal organisation and implementation of the FTS.

[1] **Mathematical Modelling and Analysis course**: https://www.ceeda.org/case-studies/mathematical-modelling-and-analysis/2021-07