WHAT ON EARTH IS RESPONSIBLE INNOVATION ANYWAY? (AND HOW TO TEACH IT)

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ABSTRACT
Our ability to rapidly develop and deploy new thinking continues to accelerate. Responsible Innovation is essential because connected systems and economic imperatives mean that the impacts of innovation, which always have positive and negative consequences, are prolific. A design-led approach can be effective for Responsible Innovation when located at the front-end of research and innovation processes and governance. This study puts forward the principles, practices and learning outcomes for a Masters that is located on a teaching-research-engagement nexus as a component of design-led Responsible Innovation Practice.

Keywords: Responsible Innovation, Design Education, Networks, Co-Creation

1   INTRODUCTION

Responsible Innovation is a particularly useful concept. It is useful because it is goal oriented not discipline or practice oriented. It is the conditioned and dependent goals of innovation and responsibility that inform the innovation projects we run and conduct research through. Responsible Innovation is not about Designers, Design Departments, or the discipline of Design; although they are important, and during innovation projects design artefacts are created to engage the project network in co-creative sense making, strategy development and goal setting. The authors are concerned with an approach to Responsible Innovation that is multidisciplinary, collaborative, project-focused and led by designerly attitudes and behaviours utilising designerly activities and resources. Our research relates to the collaborations, permissions, capacities, and capabilities that enable Responsible Innovation. In service of that agenda, a Masters programme has been developed that aims to: create capacity for organisations and communities to engage in design-led Responsible Innovation practice research; develop knowledge, capabilities and confidence to practice effective design-led Responsible Innovation practice research; produce strategic value and actionable plans for project communities based on innovation outputs. This paper is about the principles, practices and learning outcomes that this Masters programme aims to deliver.

2   LITERATURE REVIEW

2.1 Responsible innovation

Owen, Bessant, and Heintz set the context for Responsible Innovation (RI): 'innovation has not only produced understanding, knowledge, and value (economic, social, or otherwise), but also questions, dilemmas, and unintended (and sometimes undesirable) consequences' [1]. Other sources concerned with the imperative of RI and RRI (responsible research & innovation) are Stilgoe [2], de Woot [3], and Matter [4], which also provides a good overview of activities across Europe that support RI. This work raises questions about the governance of research and innovation [5], the governance of emerging technologies [6] [7], the targets of innovation and the rights and roles of the public within these processes [8] [9]. Von Schomberg's [10] definition of RI is widely acknowledged:

> A transparent, interactive process by which societal actors and innovators become mutually
> responsive to each other with a view to the (ethical) acceptability, sustainability and societal

desirability of the innovation process and its marketable products in order to allow a proper embedding of scientific and technological advances in our society.

Stilgoe, Owen and Macnaghten [11] propose an attribute framework, detailing Anticipation, Reflexivity, Inclusion and Responsiveness. They suggest that these attributes offer a more socially democratic model of moral and ethical governance for science research and innovation. Pavie, Scholten & Carthy [12] develop a process for integrating RI within organisations, situating it amongst other organisational responsibilities. They detail five stages, which are, 'comply with the law', 'anticipate future legal requirements', 'treat the value chain as an ecosystem', 'innovate responsibly' (which has a further 5-stage process), and 'lead the change'. Together this body of work has sought to understand the conditions that would allow greater inclusivity and social oversight about the governance and targets for science, research and innovation. As a counter point, Blok and Lemmens [13], provide three reasons why RI is questionable.

2.2 design-led innovation as an approach to Responsible Innovation

Bailey, Spencer and Sams [14] presented a case for the role of design-led innovation as an approach that supports RI. This paper builds on that work and will, therefore, summarise key points here. Reviewing Stilgoe et al., [11] and Michlewski [15], Bailey et al., proposed a framework for design-led responsible innovation constructed of four elements: *Deepening Empathy,* maximising proximity and contact with stakeholder networks and not just 'consumers'; *Dynamic Mapping*, employing a multiple-perspective set of lenses to map and evaluate potential solutions; *Consequence Visioning*, informing responsible decision-making by employing designerly narratives to predict and highlight both positive (responsible) and negative (irresponsible) outcomes; *Toggling*, using macro & micro, technological & social, and near & far horizons in order to consider the immediate and distant consequences of potential problems and solutions. If the case is made for 'why' responsible innovation is urgent, 'what' responsible innovation is, and 'how' it might be delivered using a design-led approach; this research questions how it should be taught.

3   METHODOLOGY

This study adopts a mixed method approach. This study puts forward thinking about how to construct and align a Masters programme to Responsible Innovation utilising a design-led approach. This study integrated understanding from three methods: (1) Document analysis and semi-structured interviews to understand the evolution of MA/MSc Multidisciplinary Innovation in tandem with academics' research agendas and institutional pressures; (2) 26 projects were reviewed to understand impact, based on process and output analysis and student and collaborator unstructured interviews; (3) Narrative analysis applied to a crowd-sourced curriculum document.

4   PROGRAMME REVIEW & EVOLUTION

Northumbria University's Master programme Multidisciplinary Innovation is about to enter its third iteration. This section considers the first two versions and highlights differences in purpose and agenda. This sets context for research leading to the new programme principles, practices and learning outcomes.

Multidisciplinary Design Innovation 2008-2012
Education in multidisciplinary innovation practice was established at Northumbria University in 2008. The programme was developed as a response to an emerging understanding of the value of 'Design-Thinking' as a multi-disciplinary activity [16] [17]. The programme was not developed to serve an established professional community. It was a Masters programme that delivered teaching and learning to its students and research data for its academics. It was a programme that developed professional capabilities and explored the value of emerging collaborative design practices. The overall aim of the programme was 'to develop advanced study of collaborative design innovation within a diverse community of graduates coming from design, engineering technology and business backgrounds' [18]. Supporting that aim were two sets of research questions:
- Pedagogy - what assessment strategy encourages creative failure; what approaches support individual and peer learning while encouraging innovation to flourish?

- Professional Practice - what physical and mental environment allows creativity to be nurtured; what approaches are effective for establishing a community of practice in which a 'common language' can be learned; and how can you promote shared values through developing self-awareness in pursuit of collaborative learning?

The programme was based on a series of consultancy-style projects working on challenges from and presenting outputs to external businesses, charities and communities. It was, therefore, a programme constructed on a research-teaching-engagement nexus. It produced experiential learning for students, design innovation project outputs for clients, and research outputs for the academics [19].

Multidisciplinary Innovation 2012-2017
There were three shifts which distinguished the second version of the programme: (1) a shift from Design discipline led multi-disciplinary innovation practice to design-led (as a set of values, behaviours, activities and resources) multi-disciplinary innovation; (2) an evolved relationship with external collaborators, which shifted the approach to projects from consultative to co-creative; and (3) a new set of research questions. The overall aim of the programme remained the same, however, the programme team felt they had the knowledge and know-how in response to the original research questions. Experimenting further with the programme, while not undermining established elements of environment and practice, the academic team sought to investigate the research questions:
- Pedagogy - How can curriculum learning be delivered to best support and align to innovation project practice; what is the value of incorporating the student cohort as co-researchers, when and how does this support ongoing research and individual's' development as innovation practitioners?
- Professional Practice - What forms of co-creative practice deliver greatest impact within our collaborating organisations; what knowledge, attitudes, behaviours, activities, resources and outputs support a design-led approach to driving innovation within organisations as an enabler of positive change?

In 2015 & 2016 the academic team published 15 papers in response to these research questions. A refined research agenda and methodology were impetus for the third iteration of the programme. A crowdsourcing event and a project impact review developed the principles, practices and learning outcomes which are the foundation to the programme and which support a design-led approach to RI.

5   EXTERNAL PROGRAMME DEVELOPMENT ENGAGEMENTS

5.1 Crowd Sourced Curriculum: Disruptive Innovation Festival
As part of the Disruptive Innovation Festival, November 2016, the authors ran a session with the aim of engaging the festival's community in a co-creative panel event to develop the curriculum for a new Masters programme in Responsible Innovation. The 2-hour session used a live streamed panel discussion, which responded to questions and content that the DIF community inputted into a structured open access document. The discussion and derived programme content was led by the following position: '*We believe that Responsible Innovation is democratic, has a social conscience and is concerned with the impact and consequences of innovations the nature of which are dependent upon their context. We believe that practice in this area is multidisciplinary and that design-led approaches help establish Deep Empathy within whole stakeholder networks to drive responsible behaviour and to ensure responsibility considerations are embedded*'. Producing content in the open access document, in real time, the event allowed the panel to explore and clarify thinking and reach consensus about how a RI Masters programme could be delivered. Simultaneously, the event allowed us to draw in content, challenges (what is the role of public engagement & how will students be able to align project thinking to political agendas and policy) and validations externally through the audience engagement.

5.2 Innovation Project Review
To support the development of new curriculum the authors reviewed 26 projects conducted since January 2015 and talked to collaborators. This review identified three forms of value generated

through our design-led innovation practice research for external collaborators - strategic assets & insights; organisational practices and processes to support an innovation culture; co-created strategy. The review also identified sets of activities and resources. One set was classified as common and accepted within design innovation and business innovation practice and one set which was novel and specifically supports design-led responsible innovation practice.

6   FINDINGS - A NEW (AND NOT NEW) MASTERS PROGRAMME

4.1 Principles

Multidisciplinary Innovation 2017 - The programme is a methodological element to the design-led Responsible Innovation Practice research group and the Strategic Entrepreneurial Leadership research group. The programme has the following principles; students learn about RI and develop design-led RI capabilities through:

- Sets of connected strategic projects; collaborations with communities and organisations, using a network approach to co-creation to drive responsible behaviour and embed responsibility considerations.
- A community of purpose that establishes a safe practice environment and a common language for its practitioners.
- The creativity of a core multidisciplinary team and the distributed intelligence of project networks to leverage new problem frames.
- Utilising practice outputs (insights, ideas & narratives) to raise ambition and engage diverse groups in co-creation.
- Utilising practice outputs (arguments, proposals & value propositions) as data in order to develop strategy to support social and organisational transformation.

Our students engage with the team of researchers, as co-researchers, through multi-stakeholder innovation projects. The programme is constructed to develop research focused on social, community and commercial design-led responsible innovation (a different approach to that of TU Delft [20]) contributing to the fields of transformative design, responsible innovation and responsible business practice. Specifically, the programme will support efforts to define practices and principles that are effective for RI by deepening empathy through network co-creation as an approach to co-created strategy.

5.2 Practices

The programme develops specific innovation practice capabilities, generates the creative confidence to develop and facilitate co-creation and enhances the employability of our students. Building on the framework for design-led responsible innovation [14] this programme, in addition to well documented design innovation and business innovation techniques, utilises:

Dynamic Mapping - Students adapt and develop co-creative activities and resources to visualise interconnected and conflicted perspectives through complex stakeholder mapping. This develops an understanding of how a complex issue is perceived and experienced. It produces a framework against which to consider impact and consequence as insights and proposals are developed.

Consequence Visioning - Using a design-led approach to iteratively develop understanding and solutions by externalizing, visualizing, and prototyping, students produce cohesive arguments for new value in relation to the existing and modified network. The arguments include detailed assessments of impact (as multiple positions on a positive to negative continuum derived from network stakeholder priorities).

Toggling - During the iterative development of solutions students identify and consider relevant macro trends and national policies to align understanding and address project specific micro issues. Students utilise a set of near and far horizons to produce innovation pathways that locate solution value and highlight the link between local issues and mega trends.

Co-created Strategy - In partnership with the project network, students produce an integrated strategy for delivering one of the innovation pathways. This includes plans for: resourcing, competency

development, supportive structures and platforms, initial initiatives, and monitoring (responsible and irresponsible) impacts.

6   CONCLUSION

One effective strategy to teaching Responsible Innovation is to locate that teaching in a nexus of teaching-research-engagement; to develop design-led responsible innovation practice competencies through strategic collaborative projects that support early research and innovation goal setting and governance. Table 1., presents the learning outcomes that the authors believe are achieved through the principles and practices of a design-led approach to Responsible Innovation.

Table 1. MDI 2017 Programme Learning Outcomes

Knowledge & Understanding On completion of this programme you will be able to:	*Intellectual / Professional Skills & Abilities* On completion of this programme you will be able to:	*Personal Values Attributes* On completion of this programme you will be able to:
1. Demonstrate critical understanding of design-led innovation practice.	4. As part of a multidisciplinary team, create actionable innovation-based strategy through critical thinking defended as responsible.	7. Establish creative confidence to enable design-led co-creation.
2. Articulate methodological value and limitations arising from design-led innovation practice research.	5. Produce and communicate solutions, in response to a complex situation, demonstrating collaborative multidisciplinary design-led innovation practice capabilities and approaches.	8. Recognise the creativity and value of multiple disciplines' principles, methods and cultural perspectives in supporting innovation practice.
3. Contextualise micro and macro issues arising from a responsible innovation area of practice.	6. Engage in a discourse with external experts and non-experts to justify and discuss a suite of innovation solutions and their consequences.	9. Apply ongoing reflexivity to situate oneself within the contexts of and the results from innovation practice situations.

6.1 Further Research

The authors have established a monitoring process that goes beyond the current institutional Quality Assurance Programme Monitoring. This monitoring will assess the effectiveness of the programme's structural elements, principles, and practices against RI impact objectives. It is our intention to report on the elements of the monitoring device and its initial findings.

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