Adaptive Curricula, an answer to changing labour market requirements

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Abstract
The automotive market shows rapid, sometimes disruptive innovations. Curriculum innovation in the professional higher education, such as the HAN\textsuperscript{1} Automotive Institute, could be an adequate response to changing labour market requirements.

Most research done on the cooperation between professional practice and professional higher education, carries an educational perspective. Enriching the curriculum design with state-of-the-art themes, and using insight in rationalities of professionals, opens a new perspective to align education and practice.

This paper elaborates on this alignment by addressing the design of an adaptive curriculum in the sixth out of eight semesters of the Automotive Institute bachelor curriculum, complying labour market requirements.

\textsuperscript{1} HAN – Hogeschool van Arnhem en Nijmegen, a professional higher education institute
1 Introduction

Small enterprises and start-ups are the driving force for sometimes disruptive innovations not only in the national, but in the European automotive market as well. The professional higher education institutes, or universities of applied sciences (EURASHE, 2012, 2015), enables the professional practice to bring these innovations to the market. The decreasing time to market of innovations (Marx & Ramioul, 2004) shows dynamics comparable to Moore’s Law (Moore, 1998). This puts pressure upon the leading themes in professional higher education curricula to comply with the disruptive innovations (Schwab, 2015, 2016). Hence, research is required to understand and to align the dynamics of the cooperation between market and (professional) higher education.

Important work has been done to understand the cooperation market-(professional) higher education, through studies on hybrid learning configurations (Cremers, 2016; Cremers, Wals, Wesselink, & Mulder, 2016 Mulder, 2016; Wierenga & Cremers, 2017). In 2002, research groups entered the universities of applied sciences (van Gageldonk, 2017), to enable applied research in professional higher education institutes and to professionalise lecturers by involving them into their research. However, to be able to adapt to changing labour market requirements, caused by rapidly developing innovations in society, professional higher education must find an answer in adapting their curricula. In this paper the labour market requirements are interpreted as complying with 21ST century skills (Binkley et al., 2014) and state-of-the-art knowledge.

In line with earlier research (Camilleri, Delplace, Frankowicz, Hudak, & Tannhäuser, 2014), researchers of HAN Automotive Research², find it hard to mobilize³ their educational colleagues of the Institute Automotive⁴, to participate in applied research on state-of-the-art themes. Conducted research emphasises the support of educational staff in adapting curricula of universities of applied sciences. Moreover, research is conducted on elaborating the social perspectives and design rationale of the learning environments (Bouw, Zitter, & de Bruijn, 2019; Cremers, 2016; Stappen & Zitter, 2016). Though social perspectives are important (Bouw et al., 2019), central in learning environments are the interacting professionals in the hybrid learning configuration. Therefore, understanding their institutional rationalities is essential⁵.

The playing field around a higher education institute is populated by three communities of professionals: 1) education: the lecturers in the role of the teacher, 2) professional practice: the company employees or professional practitioner, in the role of problem owner and 3) research: the researchers in the enabling role towards applied science. We may visualize the conflict region in the form of an adaptive learning triangle (see Figure 1-1). The professional depicted within the triangle may belong to any of the three communities. Depending on the community he/she is in, his/her conflicts will be different.

This paper aims to clarify the conflicting rationalities that may emerge by a case study: Driving Innovation. Let us briefly introduce it. For the development of the sixth out of an eight-semester curriculum of the HAN⁶ University of Applied Sciences, the Automotive Institute, an innovative design rationale has been used. The sixth semester, called Driving Innovation comprises a 30EC⁷ study load and is divided in two parts: (i) 5EC focused on predefined themes and (ii) 25EC centralized in a project.

The central topic of the project is predominated by state-of-the-art, non-curricular themes in the increasingly complex environment of the professional community, embracing intelligent solutions. In this way an adaptive curriculum is created to meet labour market requirements. This approach is contradicting the prevailing educational paradigm in the Automotive Institute that the topic of a curriculum in all

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² Part of the Faculty of Technics of the HAN University of Applied Sciences (Hogeschool van Arnhem en Nijmegen)
³ Experience learned that from educational perspective, professorships set up a research program that does not comply with the subsequent professional practice.
⁴ A Professional Higher Education Institute, part of the Faculty of Technics of the HAN University of Applied Sciences
⁵ This paper is part of a PhD-research on rationalities enhancing applied research and innovation in universities of applied sciences by understanding rationalities of (involved) professionals
⁶ Hogeschool van Arnhem en Nijmegen
⁷ 30EC, is equivalent with 840 hours study load for a student
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semesters, but the 5\textsuperscript{th} (internship) and 8\textsuperscript{th} (final thesis), is defined by curricular themes.

![Figure 1-1 Adaptive learning triangle of the interacting education-, professional- and research community](image)

This paper addresses the question: “How can curricula accommodate to and capitalize labour market requirements”, by elaborating on the curriculum design in an adaptive learning triangle. The paper is structured as follows. Section 2 provides background information. In Section 3 we discuss the method used. The first results of the curriculum development are presented in Section 4. Section 5 reflects on our findings in the form of a discussion. Finally, Section 6 gives concluding remarks.

2 Background

Most papers published on the topic of Professional Higher Education adapting to the changing professional domain, carry an educational perspective. Using for instance boundary crossing (Oonk, Gulikers, & Mulder, 2017), cross functional integration (Baunsgaard & Clegg, 2013), or absorptive capacity (Graaff, 2018) to enhance the educational organisation in cooperating with the professional practice. It was advised by Cremers (Cremers, 2016, pp. 124,125) to incorporate the professional practice in the hybrid learning configuration (Cremers, 2016; Wierenga & Cremers, 2017). Understanding rationalities of professionals in the adaptive learning triangle opens a new perspective to enhance cooperation between education, professional practice and research communities.

An important aspect of the educational process within the education community is the timetable of the curriculum; every semester is a study unit with a specific theme. Contrary to this, the daily dynamics of the research community complies with actual research interests. The consequence of this difference in dynamics is that both professional practice and research community experience a tendency to become worlds apart with respect to the education community (Adriaansen, 2005, p. 122; Griffioen, Visser-Wijnveen, & Willems, 2013, pp. 27-29).

This world apart tendency emerges at the Faculty of Technics of the HAN University of Applied Sciences within the professorship\textsuperscript{8} HAN Automotive Research (research community) operating next to the education community Institute Automotive. HAN Automotive Research is continuously focused on applied research on state-of-the-art topics in cooperation with the automotive professional community. The Institute Automotive is responsible for bachelor education for the automotive practice in an eight-semester bachelor curriculum on automotive engineering. Only semester six and semester eight\textsuperscript{9} offer the opportunity to

\textsuperscript{8} In Dutch Lectoraat (van Gageldonk, 2017), in English Lectorate or Professorship
\textsuperscript{9} Semester six starts in February 2020 for first time. Semester five is an internship, which complies with the state-of-the-art in the professional practice. However, this semester is defined as an orientation on the professional practice and as such less preferable.
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A consequence of the two worlds tendency is that lecturers and researchers are scarcely involved in each other’s community and hardly or not at all involved in the applied research projects of the research community. Yet there is a good argument to involve professionals from the education community in applied research for the research community. The state-of-the-art knowledge is a necessity for education. It enables a better connection of the competences of an Institute Automotive graduate to the labour market or professional community.

For students in professional higher education it is virtually impossible to obtain all relevant knowledge about their future professional community and to be ready for applying it after they graduate. Not new, because it is inherent to learning that after knowledge development, knowledge transfer is a different chapter. For professional higher education institutes, it could be argued that knowledge transfer is based on or originates from applied knowledge (Marx & Ramioul, 2004, pp. 91, 92). A relevant parable is the curve in product development of computers regarding the increase in computing power and the size of the memory (Moore, 1998).

To enhance the interaction of the professionals in the triangle of the education, professional and research community (see Figure 1-1), and thereby bridging the two worlds, requires understanding of both worlds. An important step herein is to understand the rationalities of the professionals working together in this adaptive learning triangle.

As suggested by Figure 1-1, the professional must deal with different rationalities: institutional (organisations) and individual (professionals), and from the perspective of the three communities. Evidently, institutional and individual rationality affect each other: though there is always an exception to the rule, no individual has a totally different and separate rationality in two worlds. The concept of rationality goes back as far as Karl Mannheim (1893-1947) (Tromp, 2001, pp. 247-250) and Max Weber (1864-1920) (Kalberg, 1980, pp. 1151-1158; Tromp, 2001, pp. 241-247). Though developed in the late nineteenth, early twentieth century, the ideas of Mannheim and Weber are still actual and representative (Wilson, 2002).

### 3 The method of curriculum development and its analysis

In this section we describe: 1) the method used by the HAN to develop the curriculum for semester six, and 2) the compliance of our analysis of it with prevailing research methods.

#### 3.1 Curriculum development

The curriculum is developed using a design group and a sound board group. The design group is an operational group of professionals from the education- and research community. And the sound board group consists of a group of stakeholders (see Table 3-1).

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The members of the design group</td>
</tr>
<tr>
<td>2</td>
<td>Professionals of the education and research community – not being a member of the design group</td>
</tr>
<tr>
<td>3</td>
<td>Professionals from the professional practice</td>
</tr>
<tr>
<td>4</td>
<td>Students from Institute Automotive from different cohorts</td>
</tr>
<tr>
<td>5</td>
<td>And, invited, not always available, members of the research and education management teams</td>
</tr>
</tbody>
</table>

*Table 3-1 Parties involved in the stakeholder group*
Table 3-2, shows the subsequent steps of the design rationale for this semester.

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Formulate the type of issues in terms of the nature and complexity of the task and the context</td>
</tr>
<tr>
<td>2</td>
<td>Design the process of implementation, guidance and assessment with roles, tasks and responsibilities, including co-creation</td>
</tr>
<tr>
<td>3</td>
<td>Process the cumulation of the practical knowledge gained in projects and the sharing of results</td>
</tr>
<tr>
<td>4</td>
<td>Determine the learning environment and the necessary resources</td>
</tr>
</tbody>
</table>

*Table 3-2 Steps of the design rationale*

This design rationale is elaborated/assessed in round table discussions with the stakeholder group.

### 3.2 Compliance with prevailing research methods

In studies on human behaviour it is basically impossible to conduct research from a positivistic paradigm, since humans are creative, independent actors and thinkers (Saunders, Lewis, Thornhill, & Bristow, 2015). In this study, we use two qualitative tools: 1) observations and 2) round table discussions. The round table discussions were organised to get feedback on the design process and gain insights in stakeholder perspectives. Observations are used to enrich this data. This method is based on interpretivism in participatory action research (Akella, 2017; Gibson, 2004). Ethnographical approach is used describing and exploring the professional in his natural working environment/work situation (Have, 1985; Lindemann, 2014, pp. 96-98; Maso, 1984). The data acquired is focused on the rationalities of the professional in the three communities: Education, Professional Practice and Research. In the first steps of analysing the rationalities of professionals, we use Mannheim (Tromp, 2001, pp. 247-250) on institutional level:

1. **substantial**: consciously acting from a holistic insight into the coherence of the events;
2. **functional**: every action has a functional role in the realization of a given goal, with the help of consistent and objectively reducible means.

An important aspect of the research presented in this paper is the researcher being project leader of the curriculum development of the sixth semester. In two ways this is considered:

a. triangulation is used to acquire data to gain insight in the behaviour of the professionals (Bryman, 2004; Hussein, 2009; Maso, 1984, pp. 77,78);

b. the (unconscious) effect of a researcher on his research is considered to assure validity and reliability of the data collection (Hammersley, 2016), (Lindemann, 2014, pp. 110-113).

### 4 Results

As mentioned in the introduction, this paper addresses the accommodation of curricula to labour market requirements by elaborating/assessing the design rationale of an adaptive learning triangle. This section presents the highlights of the results of 4 round table discussions during the design process which must be finalized February 2020. The results presented in Table 4-1 - Table 4-3, originated from the participants of the round table discussions.

#### 4.1 Round table one and two

In the first step in executing the design rationale five requirements were put forward by the design group to gain insight in the design rationale:

1. To acquire the perspectives of each party involved, a win-win-win-win situation (for lecturers, researchers, practitioners, and students) has been elaborated
2. The relevance of an upcoming research question has been discussed;
3. Since it is de facto still a part of an educational curriculum, the method of implementation, the supervision and assessment, in terms of structure and responsibility, must be clear
4. The hybrid learning configuration of the adaptive learning triangle, including time line for resources, must be clear to all participants
5. Results and knowledge amongst the participating parties in the adaptive learning triangle should be shared.

These requirements were developed in the design group and were iteratively discussed twice. Both round table discussions were led by the researcher, not participating in the discussions. The first-round table discussion (February 4, 2019) was within the design group itself. And the second-round table discussion (March 11, 2019) was in a general meeting with the stakeholders, in 5 mixed groups. Table 4-1 shows the most striking results of both round table discussions.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Findings</th>
</tr>
</thead>
</table>
| **(1)** win-win-win-win situation           | 1. Lecturers, researchers and professional practitioners, together with students learn from each other  
  2. Lecturers get the opportunity to meet the State-of -the-Art  
  3. Professional practice and professional higher education institute line up on competence development assessment  
  4. Opportunity for new cooperative research |
| **(2)** Relevance of a research question    | 1. Direct from the professional community  
  2. Students change from effort obligation to result recognition  
  3. Projects are problem focussed, not solution oriented  
  4. Students define the deliverables  
  5. Project topic must be relevant, not time critical |
| **(3)** Related to the curriculum           | 1. Development in competences; how to monitor  
  2. Role of each partner in the student assessment, tutoring, etc. More specifically with respect to the professional  
  3. Is cocreation for all involved an option/possibility\(^\text{10}\)  
  4. We strive for co-creation  
  5. Student is in the lead |
| **(4)** Adaptive learning triangle.         | 1. Professional practice is responsible for resources (money, equipment, materials)  
  2. Minimal 1 day a week at the client’s place  
  3. The project topic defines the hybrid environment  
  4. IP, secured network usage, becomes an issue. |
| **(5)** Sharing of results and knowledge    | 1. Symposium, colloquium, organised by?  
  2. Peer review by students  
  3. Sharing knowledge in multi project teams  
  4. ‘Restricted’ open access results; lecturers, researchers company professionals are invited |

Table 4-1 Results of the second-round table discussion of the design group

The results of the first-round are shown in blue. In the second meeting the results from the first meeting (blue) were acknowledged, the additional results are shown in red.

4.2 Round table discussion three

To gain more in-depth insight in the design path, a second meeting with the stakeholders was arranged. Table 4-2 shows the result of the third-round table discussion (May 6, 2019), where five uniform groups elaborated on the design path by discussing the following four topics:

1. Specific research questions;  
2. Knowledge sharing;  
3. Co-creation;  

\(^\text{10}\) In this round table discussion, it is mutual agreed that co-creation must be part of the design rationale.
### Table 4-2 In-depth insights in the design rationale

#### 4.3 Round table discussion four

To operationalise the design rationale the design group created a blue print for Driving Innovation. The blue print is subsided to a first assessment in the fourth-round table discussion with the stakeholders. The blue print has been discussed with the stakeholder group (see Table 3-1) on July 1, 2019. To enhance the support in both education and research communities, both management teams were invited and participated. In see Table 4-3, the most striking results are shown, given by professionals from the three involved communities.

<table>
<thead>
<tr>
<th>Community</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Good document in educational perspective, missing the project typing and activity time line. Clear how co-creation hours for teachers (education professionals) can be funded</td>
</tr>
<tr>
<td>Professional Practice</td>
<td>Do not yet see clearly what their role is. Clear on IP and (again) discussion on costs. Companies should have at least be consulted on student ratings.</td>
</tr>
<tr>
<td>Education - Lecturers</td>
<td>Good overview, however, practice is unruly; discuss and hold on to responsibility (not common at all).</td>
</tr>
<tr>
<td>Education - Students</td>
<td>You must be judged on those things that are indicated to be judged, so don't give yourself away for the group's sake if that means that your own work will be below the level. If you also do other things, this certainly works to your advantage.</td>
</tr>
</tbody>
</table>

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11 SME – Small Medium Enterprise, representing the community professional practice
12 Students are accounted for in the community education
13 Added by the author, based on the previous round table meetings

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5 Discussion

In the daily practice of Professional Higher Education, professionals from the education community develop the curriculum. Generally, a less discussed subject herein is the perspective from the professional practice (Cremers, 2016, pp. 124,125). At the Automotive Institute an innovative step was taken to mend this shortcoming. In the development of semester six - Driving Innovation – three initiatives are leading:

1. The semester curriculum theme will be defined by the state-of-the-art of the professional practice, contradicting the prevailing approach in curriculum development.
2. The link with professional practice is monitored and evaluated on a regular basis in the sound board group on the curriculum development, and;
3. Co-creation by all professionals involved in the adaptive learning triangle is stimulated effectively weekly based project meetings.

In this way Industry 4.0 (disruptive) innovations (Schwab, 2015, 2016) will find their way to the curriculum, despite short time to market constraints (Marx & Ramioul, 2004). These innovations will put pressure on the role of the professionals; all involved professionals will have to act in the perspective of a network professional (Vijlder, 2015). And roles of research-active professionals in universities of applied sciences can be enhanced (Schuiling et al., 2011; Winkel, Rijst, Poell, & Driel, 2017), to better comply with roles required when acting in the adaptive learning triangle.

The different world axioma

As discussed in the introduction and background, the worlds of ‘Education’ (education community) and ‘Research’ (research community) are different worlds (Adriaansen, 2005, p. 122; Griffioen et al., 2013, pp. 27-29). Table 4-1 is a consequence of the different world axioma. During the meeting with the design team (February 4, 2019) more educational driven themes were discussed (see Table 4-1, blue remarks). During the meeting with the stakeholders (March 11, 2019), in which the professional practice was well represented, the focus shifted towards results and consequences (see Table 4-1, red remarks). For example, co-creation in the perception of the design team was an ‘option or possibility’, this changed to a goal (‘strive for’). Or on knowledge: the scholarly participants screamed for open access and open availability. Whilst the professional practice calls for IP and secured network usage. This ‘different world axioma’ is also illustrated by the students. They mentioned to expect an excessive workload, where the study load just complies with regulations, as before. Or ‘time spent to the project must comply the grading system’. On the other hand, ‘less reports, more verbal assessments’ does comply with current developments in the professional practice. In meeting 3 (May 6, 2019) the role of the professional practitioner is evaluated as valuable for the education community. However, when it comes to judging the development of the student there’s no consultancy foreseen in the RACI14 in student assessments.

The Hybrid Learning configuration

Various studies showed the importance of a hybrid learning configuration (Bouw et al., 2019; Cremers, 2016; Cremers et al., 2016; Stappen & Zitter, 2016; Wierenga & Cremers, 2017). In addition to this discourse on hybrid learning, this paper emphasizes the importance of an adaptive curriculum, meeting labour market requirements, i.e., the central theme of the curriculum is unknown prior to running the semester. The importance of the adaptive learning triangle was confirmed in all three round table meetings (see Table 4-1, 2 and 3) where stakeholders emphasized the importance of an adequately defined and set up hybrid learning configuration.

Discussions reflected in Table 4-1, 2 and 3, also showed that the physical location of the adaptive learning triangle is not important:

- The professional practice emphasises on minimal 1 day a week at the company;

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For the research community and education community, it is quite indifferent. Whilst both emphasises and comply with the at least one day a week” at the company.

Rationalities
As mentioned in footnote 5 (p. 3) this paper is part of a PhD research focused on rationalities of professionals. Understanding institutional rationalities and using an innovative design rationale can contribute to improve the professional interaction in an adaptive learning triangle. Thus it offers an opportunity to reduce the perceived discrepancy between the worlds of research and education, e.g. their themes in educational curriculum (Adriaansen, 2005, p. 122; Griffioen et al., 2013, pp. 27-29).

The round table meetings with the stakeholders offered a unique opportunity to observe rationalities as they emerged. Surprisingly, an interesting distinction has been observed in (i) the economic field, (ii) the research paradigm and (iii) the time perspective of the primary process.

The professional practice shows a clear focus on the costs (see Table 4-2 and Table 4-3). The return on investment is a prevailing attitude. These issues were not raised by the education- and research community. They considered the cost coverage aspect in terms of “Professional practice is responsible for resources (money, equipment, materials)” (see Table 4-1, item 4).

Similar effects show the attitude towards the research paradigm. For the SME, this calls for Intellectual property transfer: IP rights are for the SME (see Table 4-2 and Table 4-3). Education is focused on research attitude, and mainly thinks in terms of “design”, “produce”, and the research community is in this perspective focused on knowledge and knowledge development.

<table>
<thead>
<tr>
<th>Rationality of Acting / Rationales</th>
<th>Education</th>
<th>Research</th>
<th>Professional practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic perspective</td>
<td>Costs coverage annual reports</td>
<td>Costs coverage monthly reports</td>
<td>Shareholder value, Return on Investment</td>
</tr>
<tr>
<td>Research paradigm</td>
<td>Research attitude, designing, realization, services, ...</td>
<td>Applied, Practical research</td>
<td>IP focused, USP-P</td>
</tr>
<tr>
<td>Primary process - Time perspective</td>
<td>A four-year curriculum, containing eight semesters</td>
<td>Continuously driven by state-of-the-art themes from the professional practice</td>
<td>Continuously driven by innovation and market</td>
</tr>
</tbody>
</table>

Table 5-1 Initial Frame Work on Institutional Rationalities

Table 5-1 shows a part of the initial framework of institutional rationalities originating from the referred PhD-research. This table shows a coherent compliance with the observed rationalities emerging throughout the stakeholder meetings.

6 Concluding remarks
This paper addresses the question: “How can curricula accommodate to and capitalize labour market requirements?”. We elaborate on this alignment by addressing the design of an adaptive curriculum in Driving Innovation, the sixth semester of the Automotive Institute bachelor curriculum of the HAN University of Applied Sciences. Central in this semester is compliance of the curriculum with state-of-the-art professional practice.

The curriculum is developed using a design group and a (broader) sound board group. The latter is a mix of lecturers, researchers, practitioners, and students. We closely followed 4 round table discussions of the sound board group. These round table meetings offered a unique opportunity to observe rationalities as they emerged. Our observation confirmed - once more - that the worlds of ‘Education’ and ‘Research’ are different worlds. Lecturers focus on educationally driven themes, whereas the professional practice focuses...
on results and consequences. For example, co-creation is for the lecturers an ‘option or possibility’, but it is a goal for practitioners.

Three guidelines - so far emerging from the above design process - may be of general value: (i) define the curriculum theme by state-of-the-art professional practice (ii) monitor and evaluate the link with professional practice on a regular basis (iii) stimulate co-creation of all professionals involved.

By doing so, we will create a better mutual understanding (and hence cooperation) between professionals in the adaptive learning triangle. This creates the opportunity to deal with the ‘two worlds’ axiom and to develop a curriculum complying with the actual research interests of the professional practice.

Further research will be carried out on understanding in more detail the individual and institutional rationalities of professionals operating in the adaptive learning triangle in order to enhance cooperation between education, professional practice and research communities.

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Appendix 1 Design Rationale from Project Management Plan