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EXPERIENCES WITH THE TECHNICAL ACCREDITATION SCHEME (TAS) - "TEACHING THE TRAINEE"

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Abstract

There is a gap in hybrid vehicle, automotive electrical / electronic and embedded systems expertise in the UK. There is a demand for new and different skills than those traditionally associated with the automotive industry. Traditional models of taught undergraduate programmes with relatively narrow disciplines are deficient as the automotive industry's need is at the boundaries and overlap of traditional disciplines. Recently-qualified engineering graduates need additional specialist training to make a significant input in such areas. Until recently, addressing this gap remained a significant challenge to automotive companies in the UK.

The Technical Accreditation Scheme (TAS) launched in 2010 by Jaguar Land Rover (JLR) in partnership with leading UK Universities provides the platform to deliver high impact, relevant, specialised, state-of-the-art solutions to bridge this gap. Success lies in the integration of personal experience and knowledge of Subject Matter Experts (SMEs) with relevant theory ensuring both academic outcomes and real-world needs for usable skills are addressed. This is done with the backdrop of a number of challenges ranging from the experience and background of cohorts, understanding the level of pre-requisite learning required and balancing the teaching versus training paradigm. Nevertheless, there has been universal positive feedback from participants and sponsors for the TAS modules delivered by WMG at the University of Warwick.

The success of the scheme has led to it being opened up to the UK manufacturing and engineering supply chain employers through the Advanced Skills Accreditation Scheme (ASAS). In addition, make a significant long term impact means providing access to non-traditional disciplines earlier through schools and colleges. The WMG Academy for Young Engineers at the University of Warwick will achieve this through a new state-of-the-art school providing young people interested in engineering access to realising their ambitions.

Keywords: Technical Accreditation Scheme, Jaguar Land Rover, WMG, Automotive, Skills-gap, Higher Education.

1. INTRODUCTION

The automotive sector is a vital part of the UK economy with a £50 billion turnover and £10 billion value added to the economy. Representing the interests of the UK automotive industry at home and abroad, the Society of Motor Manufacturers and Traders (SMMT) has outlined the following key challenges for the industry in relation to engineering skills (Commons, 2012):

- High-quality engineering skills are critical to the sector's competitiveness and growth.
- The industry employs a workforce with a range of levels of skills and supports widespread up-skilling to meet present and future needs.
- A shortage of engineering skills is present in the UK, automotive supply-chain companies find recruitment of engineers particularly challenging.
- Engineering graduates often lack the practical "hands-on" engineering skills applicable in a working environment.

The success of the automotive industry in the UK is heavily dependent on having access to a large, highly-skilled, and flexible talent pool that can cater for a diverse array of complex manufacturing processes. In addition, the fast pace of technological development within the automotive sector, particular in the area of low carbon vehicle technologies and electronic & software systems, requires a constantly evolving skills base in order for the UK to remain internationally competitive.

At present the engineering skills base in the UK does not meet industry needs, creating a real barrier to growth in the sector. 24% of companies that the sector skills council for Science Engineering and Manufacturing Technologies (SEMTE) engages with recorded skills gaps in 2009, (SEMTE, 2010) and over 60% of employers in the science, engineering and IT sectors have difficulty recruiting individuals with Science, Technology, Engineering and Mathematics (STEM) skills.

More attention is needed to ensure that engineering students are equipped with skill-sets that are directly applicable for UK businesses. Anecdotal evidence has illustrated that this issue is most widespread amongst engineering graduates, who often do not have hands-on experience with the right technologies/equipment and therefore require additional training (Commons, 2012).

One of the ways in which WMG, at the University of Warwick is meeting this challenge is through the development of the Technical Accreditation Scheme (TAS) with Jaguar Land Rover (JLR).

The drivers for the scheme are to:

- Ensure that existing company staff are taught the state-of-the-art in the most relevant areas
- Improve productivity or ways of working within the business
- Provide a conduit for sharing best practice and sharing lessons learned
- Help create and apply new knowledge (or to exchange subject knowledge) – the partnership between WMG and JLR encourages the flow of knowledge (two-way) often at the leading edge of research
- Motivate staff and build relationships; in addition to developing the capability of employees, the scheme is designed to motivate and retain staff within the company

To date 33% of JLR engineers have registered on a TAS module (The Manufacturer, 2013).

2. UNIVERSITY / INDUSTRY PARTNERSHIP

The TAS scheme is underpinned by a strong partnership between WMG and JLR. WMG's collaboration with JLR has grown over a number of years and has resulted in the company relocating their Advanced Research Group in WMG on the University campus. This collaboration is further strengthened by JLR's decision to spend more than £100m on collaborative research programmes

with WMG over the next few years. In addition, Tata Motors European Technical Centre (TMETC) is expanding its team of highly skilled engineers who are based in WMG by 40% over the next few years.

WMG is a lead partner in a number of projects that bring together global companies, SMEs and universities. Examples include the completed £29m Low Carbon Vehicle Technology Project and current the High Value Manufacturing (HVM) Catapult Centre. The HVM Catapult's network consists of seven technology and innovation centres, established and overseen by the Technology Strategy Board, with over £200 million of government investment. The Catapult provides UK business with a gateway to access the best manufacturing talent and facilities in the country. WMG's ability to develop and deliver the TAS scheme is predicated on this solid foundation of working with automotive companies on cutting edge research.

3. TECHNICAL ACCREDITATION SCHEME

TAS has been designed in partnership with JLR with the focus on providing employees with the benefit from the latest knowledge to benefit directly their day to day activities. Participants can select from more than 50 course modules covering different advanced skills and technologies such as hybrid technology or sustainable powertrains. These count towards a qualification up to a Master's level degree, (Figure 1).

The scheme is run by WMG at the University of Warwick and delivered through collaboration with a network of leading Universities, with each module delivered by a University chosen for its research expertise for a given topic. The universities participating in the scheme are Bradford, Coventry, Cranfield, Loughborough, Southampton, Warwick and York.

Modules are valued at either 10 or 15 CATS points where 1 CATS point equates to 10 hours of study. All accredited modules have a compulsory Post-Module Assignment (PMA), designed to embed knowledge attained during the taught component of the course. Depending on the number of CATS points accumulated, the student can gain either a Postgraduate Certificate, Postgraduate Diploma or ultimately, an MSc by gaining 180 CATS points (Figure 1).

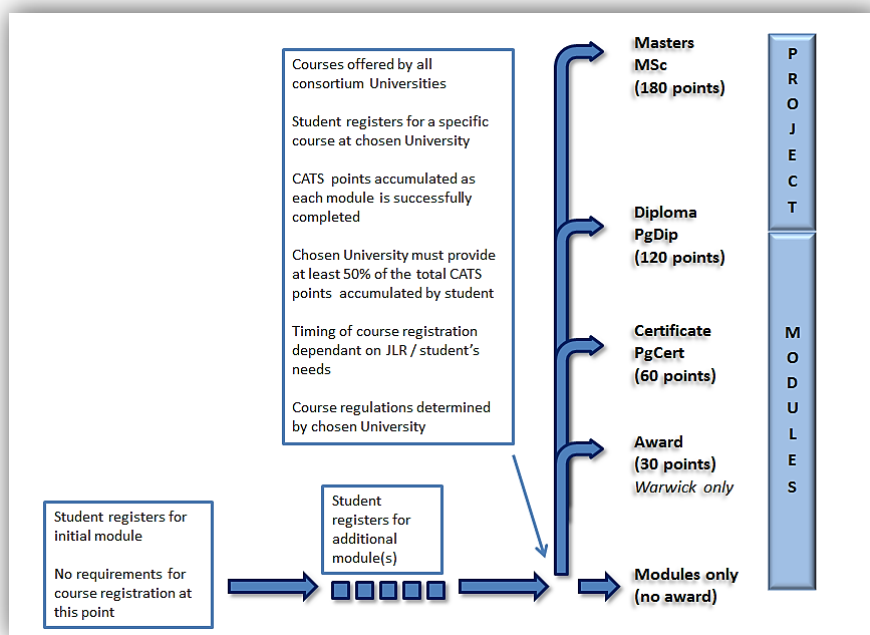


Figure 1: Technical Accreditation Scheme Credit / Awards Framework

In developing the TAS modules, WMG resisted the convenient approach of recycling its conventional postgraduate modules and repackaging them under the TAS badge. Instead, each module has been developed from the ground up, in consultation with technical experts from the automotive industry. Key factors that were taken into consideration included understanding the critical challenges for the business, the associated gaps in skills / knowledge, and the demographic of engineers affected.

One of the key themes that emerged from the consultation process was the necessity for a blend of theory with practical exercises to embed knowledge. This places a major challenge on the method of delivery and also the demands in terms of the facilities, rooms, equipment and the personnel needed to deliver a high quality course. However, the results have been very positive with the learner feedback indicating this aspect as a particular strength of WMG modules.

Over the past three years the range of modules, provided by the Embedded Systems and Hybrids groups at WMG has evolved to include the following:

- Advanced Test Techniques for Electrical Systems and Software
- Automotive Networks
- Automotive Diagnostics
- Hybrid Vehicles: Hybrid System Technologies
- Hybrid Vehicles: Practical Component Testing
- Robust Automotive Electronics
- Robust Automotive Software
- Systems Modelling and Simulation

The campus-based modules are delivered in five consecutive whole days. Group size is limited to a maximum of twenty students and the session length varies. The theoretical underpinning knowledge is taught using a variety of teaching styles designed to encourage questioning, debate and discussion. Learning is reinforced using syndicate classroom-based exercises and/or or a practical, hands-on tasks.

4. ISSUES AFFECTING TEACHING

Delivering TAS modules has posed a number of challenges. These can be seen from a learner's or a teacher's perspective.

4.1. Learner-related issues

One of the strengths of the TAS scheme is that the modules are intended to be accessible to any eligible delegate regardless of prior knowledge. However, the diverse range of skills and experiences that the learners arrive with does pose a challenge for the teaching team. For example, many of the individuals attending the electrical engineering courses tend to be non-electrical engineers. As their role within the company has changed or as technology has evolved, these delegates are driven to attend the courses in an effort to strengthen their knowledge in the area of automotive electronics. Unlike, other conventional postgraduate modules, TAS modules have no formal entry requirements.

In order to reduce the impact of this issue delegates are required to complete a learner profile sheet which outlines each delegate's prior knowledge against each of the subject areas, and return it to WMG before the course starts. This information is used in a number of ways which includes: formulating 'well balanced' syndicate groups, identifying delegates with a lack of prior knowledge or those with extensive knowledge so the lesson plans can be adapted to ensure effective engagement for all throughout the course.

4.2. Teacher-related issues

Due to the smaller group sizes and the more interactive nature of a TAS course, the TAS Professional is distinct from a more conventional University Lecturer (figure 2).

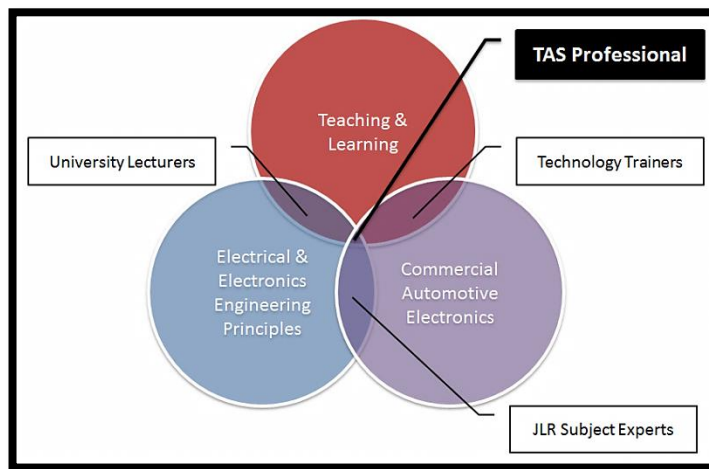


Figure 2: The TAS Professional

Figure 2 demonstrates the attributes needed for a TAS Professional. From experience, finding someone to fulfil the role of a complete TAS Professional due to the very specialist needs of the programme is very difficult. Ideally a subject matter expert who is an experienced teacher with an academic background is required. The reality is that this specification of person is rarely available.

For the Teaching & Learning aspect, they need to possess an extensive pedagogical toolbox. They need to be comfortable leading, facilitating or moderating an interactive workshop-style taught session where the delegates share ownership in the knowledge sharing process. They need to be equally at home delivering a laboratory session using the latest commercial automotive technology and standards. This is in contrast to the more established style of university lecturing, located in a more 'traditional' setting relying on a more didactic, unidirectional teaching model.

In the light of not finding the ideal specification of person, WMG have deliberately used subject matter experts (SMEs), both from within JLR and the supply chain, to deliver elements of the TAS courses. This brings a range of advantages and disadvantages. The key advantage is the extensive real-world experience tutors bring with their detailed understanding of applying the technology in a commercial context. They are able to effectively bridge the gap between the theoretical concepts and the application of the technology by referring to actual lessons learned.

However, as figure 2 illustrates these Subject Experts are not expert teachers. For example, they don't regularly check if all learners have understood the material being taught, or use effective methods to better engage the quieter members of the group. However, despite these limitations the richness of experience that the Subject Experts bring outweighs their lack of teaching experience as demonstrated by very favourable responses from the delegates.

One of the inherent risks with this approach is that if the course being delivered largely by a JLR expert, the course can become too company-specific. It can focus more on the business processes rather than the underpinning academic knowledge, resulting in more of a training module than a teaching course.

5. ASSESSMENT

To meet this ambitious aim delegates need to do more than simply attend a week-long course. They need to apply their learning to real-world business activity in a manner that is more structured, logical and scientific requiring practice, analysis and evaluation to gain a richness of understanding. The Post Module Assignment (PMA) is designed to do this. The PMA requires delegates to actively seek and engage with technical experts within the wider business context to where specific expertise lies in the business and to realise that problem solving is most effective when you are able to use the resources available to you.

The PMA enables learners to build-up confidence in the techniques of applying the knowledge and to demonstrate whether the module learning outcomes have been achieved. In successfully completing the PMA delegates need to demonstrate that they have:

- become familiar with the body of knowledge covered in the module;
- mastered the application of this knowledge;
- effectively communicated this application;
- critically assessed the constraints and limitations of the application of this body of knowledge and discussed them in a coherent manner.

6. Results

6.1. Post Module Assessment Submission

Although delegates are reminded throughout the course of the importance of the PMA and its purpose, the submission rates still vary. As Figure 3 shows the percentage of delegates who submit for assessment varies both from module to module and between different cohorts on the same module.

Figure 3 shows the number of PMA submissions per cohort per subject module over time with the oldest cohorts arranged to the left and most recent arranged to the right.

Two of the modules, Systems Modelling & Simulation (SMS) and Hybrid Vehicles: Practical Component Testing (HVPCT) run only once a year and both show submission rates in excess of 80%. Both modules were also on their first active roll out. It will be interesting to see if the submissions from the second run of both modules still show high submissions

Overall there is no clear evidence of a pattern across the modules as a whole. However, when looking at the submissions per module it is evident that Hybrid Vehicles: Hybrid Systems Technologies, (HVVST) constantly achieve submissions over 70%, whereas Robust Automotive Electronics has significantly less.

There are a number of variables that may account for the variation. For example, WMG has observed that the modules are taught by different people, group size varies between modules; delegates may come from different departments and/or have different levels of responsibility in the business. The delegates have reported, through the end-of-course feedback a number of other variables from their viewpoint. For example, currently all TAS delegates are given 12 weeks for submission of the PMA. Delegates are expected to complete the PMA during their non-working time. Unfortunately, this appears to present a significant barrier for some learners, due to work commitments and an inability to allocate significant personal time to complete the PMA.

Analysing the data shows that there is an anomaly between this particular point and the submission rates. Despite the same time pressures a high percentage cohorts in some of the modules still successfully submit PMAs.

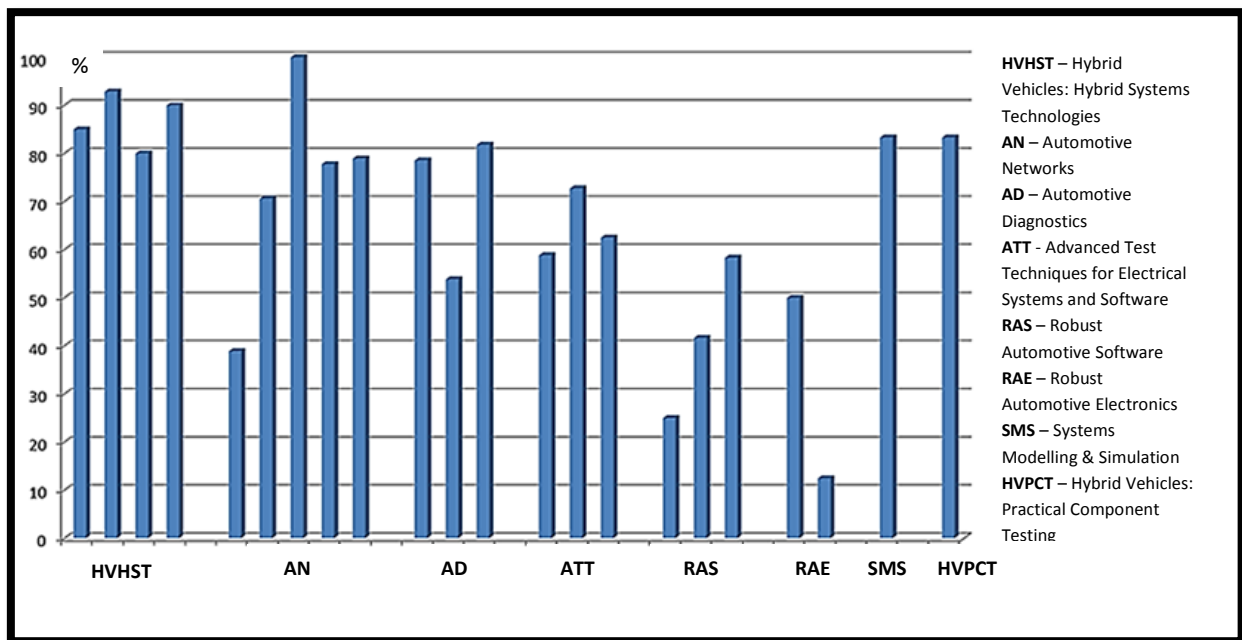


Figure 3: Percentage of delegates who submitted for assessment

Another factor cited by delegates is that they already possess an equivalent or higher level of qualification and view the PMA only as a vehicle for obtaining an unnecessary, surplus qualification, despite the explanation of the purpose of the PMA in embedding learning. It is possible that the learning value of completing the PMA is not fully appreciated by these learners. Further analysis of the data is needed to look at how many people with such qualifications do and don't submit.

Through our experiences to date, the issue of submissions has gone from one that was largely hidden during the early days of the programme to one which has gained recognition, by both JLR and WMG. JLR's training team now actively monitor submissions and dealt with via the line management chain.

It is also recognised that more work needs to be done in evaluating the resulting change in work practices of delegates after attending a TAS module. Some of the themes the research can include:

- A comparison in the resulting change in work practice between delegates who submitted for assessment and those who did not to submit for assessment
- Understand the real reasons for non-submission
- Perceptions and effectiveness of the PMA as an assessment tool.
- Alternative assessment tools that would enable the effective embedding of the learning

7. MEASURES OF SUCCESS

Feedback from participants plays an important role in the maintenance of quality and standards on the TAS programme. Participants are encouraged to record comments about each taught session throughout the course. At the end of each session participants are prompted to record their impressions of the sessions on a tick-box, questionnaire and at the end of the course via a formal group feedback session. The following results demonstrate the level of success of the modules against three criteria: Module Suitability, Breadth and Depth and Overall Impressions.

7.1. Module suitability

Figure 5 and Figure 4 show that the majority of delegates felt the modules met their learning expectations and were appropriate in scope and intended level of knowledge.

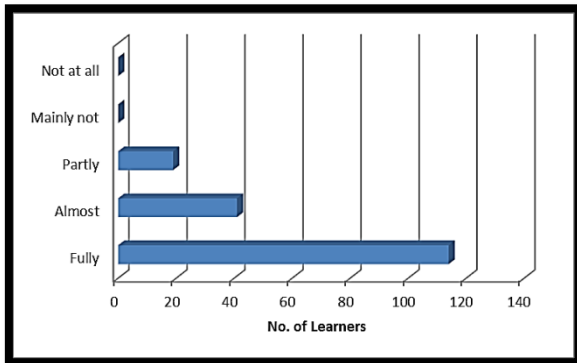


Figure 5: Were the stated objectives appropriate in scope and intended level of knowledge of the subject?

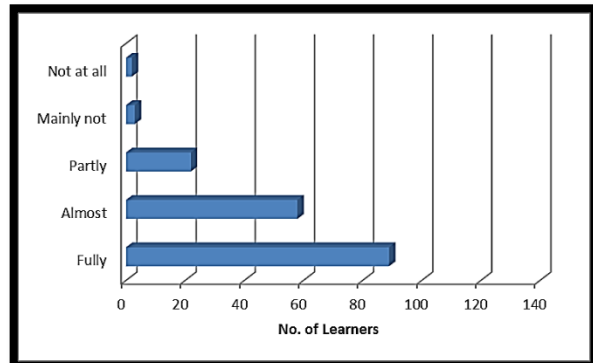


Figure 4: Were delegates personal expectations met?

However, it has been recognised that for some delegates there exists a discrepancy between the course contents and their perceived expectations. The expectations are broad simply because the TAS modules do not have any formal entry-level qualifications and the cohort is composed of a mix of experiences. This presents both the delegates, (with little or no prior knowledge of the subject) and the teaching team with additional challenges which can impact this criterion.

7.2. Breadth and Depth

As mentioned previously, the WMG modules were developed from first principles for JLR. This has resulted in some excellent responses from the delegates who have attended the modules. Almost 70% of the delegates reporting that the breadth of the modules is appropriate (Figure 6), and 80% felt that the depth of the modules was appropriate for their needs (Figure 7).

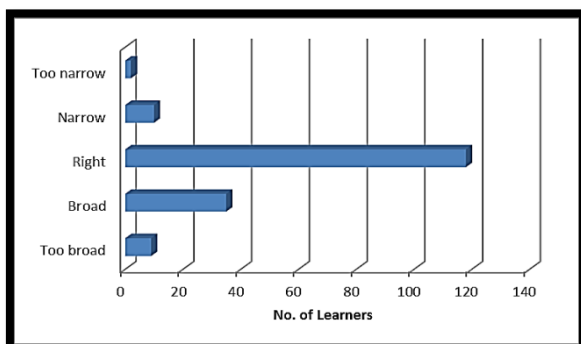


Figure 7: Breadth of the subject matter covered?

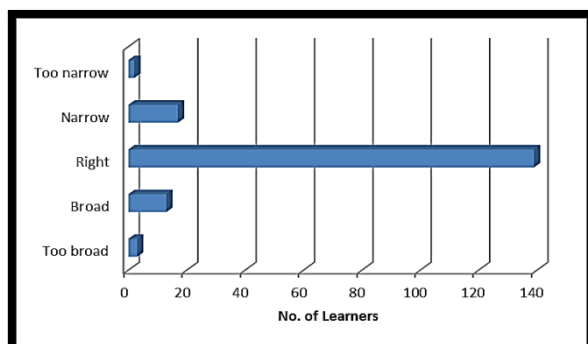


Figure 6: Depth of the subject matter

7.3. Overall Impressions

A significant amount of resource has been employed by WMG in developing the modules that collectively make up the TAS. In addition, the approach of working in partnership with JLR at every stage of developing and delivering the modules has yielded some very promising feedback from the JLR delegates. Encouragingly, 89% of the delegates (Figure 8), who have attended a TAS module, have rated it as either 'Good' (48%) or 'Very Good' (41%).

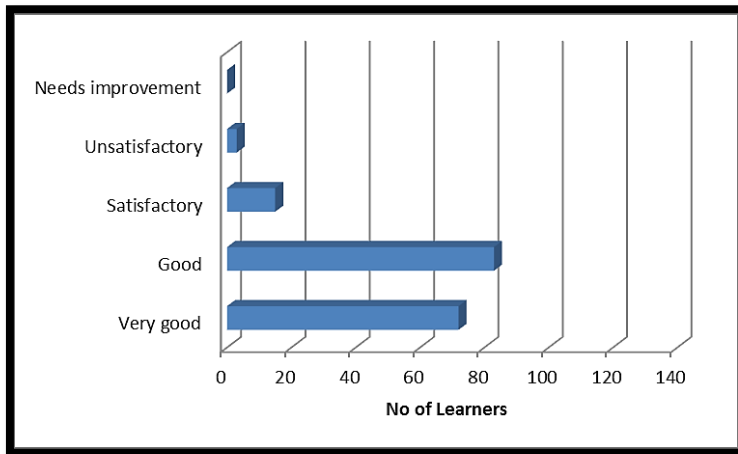


Figure 8: Overall impression of the TAS module by delegates

Conclusions

The Technical Accreditation Scheme (TAS) has proven to be a model of excellence in how Universities can work in partnership with industry to develop and deliver cutting-edge courses. The response to the TAS courses run by the *Hybrid Vehicle and Embedded Systems group* has been excellent from both delegates and their employers. A key positive feature of the existing modules is the richness of Jaguar Land Rover-specific, real-life experiences and practical examples shared.

A number of avenues for further work have been identified. Going forward, the focus is on how to improve the learning experience for delegates. This will be done through the incorporation of more blended learning content, online Information Advice and Guidance content and enhancing the support framework WMG provides for subject experts who are new to teaching. There is also a demand for the development of additional modules in line with the business needs of JLR.

The challenge now is how the modules that have been developed for a single automotive manufacturer can be modified for a wider group of OEMs and the supply chain. JLR have endorsed this development and recognise the invaluable opportunities for sharing ideas and practice that can be gained through cohorts of delegates from a range of different companies.

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