Canadian Council for Aviation & Aerospace

REPORT

CCAA Micro-Credential for In the Flow of Work Training Project

Aviation Inspection

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Future Skills Centre

REAL SERVICES CANADA

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FSC is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead. The Future Skills Centre was founded by a consortium whose members are Toronto Metropolitan University, Blueprint ADE, and The Conference Board of Canada

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SECTION 1 Overview: Sector, Training & Research

The Aviation and Aerospace industry is faced with many of the same human resource challenges as other sectors across Canada. Of the numerous challenges, the ability to recruit, train, advance and maintain a qualified workforce are some of the leading issues that require constant vigilance and attention by companies of all sizes in this sector.

The Canadian Council for Aviation and Aerospace (CCAA) has analyzed and reported on the overall labour market conditions within the sector for many years, identifying the key indicator and factors that do - and will - pose significant issues for the sector if trends continue and solutions are not forthcoming. The key and critical resolutions that are required to address the labour market and workforce issues rest on the plates of various stakeholders who must act in collaboration and coordination to be successful. Other solutions will require governmental and institutional (e.g. education, sector roadmap) circumspect and transition to meet current sector needs, economic and market conditions, and be able to tackle international impacts and competitions for qualified workers that will either solve or negatively impact the entire sector in Canada.

Summarily, the key issues that face and challenge the sector in regard to the available 'labour' pool and workforce can be identified in the following main categories:

- An aging workforce that will require significant replacement numbers in addition to hiring for growth.
- Limitations to attracting entry level workers to the sector through feeder programs that support and appeal to younger workers and recognition for potential candidates from other sectors.
- Limitations to the number of programs that offer direct education and training for many of the occupations found in the sector and for which specialized or formal training and education programs do not exist.
- High levels of education and experience required for some occupations (e.g. engineering, science, and technology degrees) but which there are limited career and education paths into the sector while being faced with competition from all other sectors requiring this education qualification.
- International competition for skilled workers that is posing a significant challenge to keeping employees within Canadian companies, especially small and medium enterprises, as wage opportunities, career advancement and professional development provide attractive opportunities for Canadian workers moving abroad. As a corollary, Canadian companies are now having to seek international workers who can fill vacancies across many occupational groups but whom may have not received the same training as in Canada or meet the certification/licensing regulations required in our country.
- Various obstacles and barriers that exist in recognizing credentials for foreign workers to enter Canadian companies and occupations from other countries.

The current situation within the sector's workforce shows a profound need for all stakeholders to identify and establish effective solutions to address the key issues. In their 2021 review of the sector with respect to initial impacts of the pandemic, it was noted that *"because of previous drastic cost saving measures, an increased number of often experienced Aircraft Maintenance Engineers (AMEs) amongst many other occupations have either retired or changed their fields and industries of employment permanently."* The impacts of this issue are occurring 'now', so solutions are required 'now' as well.

When the demand for skilled workers is significantly outpacing the supply, shortages will occur and practices such as poaching become more commonplace as companies strive to maintain their competitiveness and production levels. Additionally, the traffic patterns of workers leaving smaller companies within the sector to larger ones that often compensate higher, the impact on smaller enterprises can be even greater in proportionate terms. It often leads to a conundrum for training – companies need to train and certify their workers to both external and internal levels and standards, but this investment is not inexpensive and if it leads to workers leaving regularly then companies are reticent to make the full commitment. Simultaneously, if companies don't train their workforce to the high standards required then they will also be negatively impacted, threatening their competitiveness and ultimate survival.

As was clearly identified by the stakeholders to this project, "those companies that manage to retain and attract respective professionals will develop a significant competitive advantage and find themselves in a well-founded position to increase their market shares." This reality helped crystallize the need for the industry to implement the necessary systems needed to train and upskill in the workplace.

A pivotal element in the development of a digital learning resource for this occupation, and for the future ones envisioned, is to ensure that such systems are accessible to as many workers and employers as possible. Larger companies with more significant financial and human resources available for training are often able to 'weather a storm' – such as the pandemic – and continue to invest in sound and critical training programs, sometimes handling most elements internally. However, the 'democracy' of workforce training to assist Canadian companies and their workers means that all elements of the sector and all sizes of companies need to have equitable access to leading training or the industry 'as a whole' will not be competitive.

This sector is not immune from the challenge of developing and delivering multi-faceted, high level, innovative and current training, and professional development. There exists a range of gaps, barriers and challenges for employers and workers alike in finding or obtaining: the specific training; accessible in cost or geography; relevant and current to a specific occupation; recognized by regulatory and licencing standards; flexible to meet employer and worker schedules and timeframes without impacting production; robust enough in foundation to assist entry level workers or accredit foreign trained workers.

Training needs to be seen as a continual journey, not a destination, and needs to provide compelling results and evidence that it will contribute to the industry and occupational requirements and overarching goals for the company, sector and national economy. Ultimately, successful workforce training and development needs to deliver – deliver skills and qualifications to the workers to ensure they have leading edge skills and any licencing requirements, and to companies to achieve their bottom-line results that allow them to succeed in a competitive market and maintain their existence.

This project – its purpose, content, and delivery - represents an initial foray into in the flow of work and industry led training. It represents a model that, if successful, can offer a significant, advantageous tool for those in the sector who must reach worker, industry, and individual company objectives.

The key areas that underscore this opportunity and which affirm the purpose of the project include:

1. Utilizing a digital training environment that can supplement the requirement for classroom-based delivery, in part or whole.
2. Through micro-credential foundation, supports customized and just-in-time training for workers that can be implemented in various ways including 'in flow of work' aspects.
3. A digital logbook resource that mirrors and supports other occupational training systems through validation and certification of skills and competency levels by an accredited or designated supervisor/professional.
4. Joint elements of 'self-directed' learning for workers that can be integrated into employer-based instruction and certification.
5. Through virtual training capacity, allows for accessibility to all candidates from any geography and company.
6. Industry driven content that allows for flexibility and for core, baseline standards that can be recognized and as required, modified to meet changing occupational or regulatory needs.
7. Foundational and linked training and qualification elements that align with, and support, skill levels and certification requirements for governmental regulations.
8. Opportunity for direct, continuous improvement by both learners and workers in conjunction with employers and qualified professionals from the industry, something not always available through third party institutions and training facilities.
9. Provides an opportunity to test and verify a component of the system developed with separate funding.

This project was envisioned, and established, as a new approach - a training paradigm shift. Its focus was to offer new opportunities to those engaged in the workforce and with a goal, and need, to gain current skills and knowledge for their existing duties, while aiding their career and employment advancement. There were multiple elements at the core foundation of the project that were simultaneously being developed and evaluated to assist existing workers and employers acquire skills and competencies and in an effective, flexible manner as acknowledged and recognized by employers, regulators and the overall industry.

Industry stakeholders in consultation with CCAA and subject matter experts framed this project, and the anticipated system that would be developed to upskill existing workers using an 'in-flow-of-work' model.

This approach required the input of industry leaders and subject matter experts in its design and implementation, including individuals who require and will take the training to the companies and mentors who must ensure the resources are current and relevant and required standards.

From this basis, the main tenets which become the focus of project and subsequent research and evaluation were:

1. Integration and application of digital technology for training that allows accessibility to more parties and underscores an 'in-flow-of-work 'approach to skill and competency development for workers and employers.
2. Establishment of a 'micro-credential' framework and system for a unique skill set (aviation inspection) and the associated competencies which will allow for customized and individualized approaches to training and upgrading according to the needs of a worker and/or their company.
3. Utilization of developed occupational standard that supports the industry need for training

and skill development, allows workers to gain the requisite skill sets, and supports a consistent system that can allow for recognition and certification of workers across all parts of the sector.

4. An accessible system that is flexible in application, can be integrated into a 'flow of work' setting on the job, and can be supplemented by coaches and mentors in ongoing and specific employer training programs.
5. Building on tenet 4, the creation of occupational standards, skill and competency levels means that the industry has the framework to enact training and can establish the most effective mechanism and structures to utilize them, whether fully digital and self-directed for one example or to instructor delivered with in-person (e.g. workplace) delivery.

The development of a Micro-Credential framework was key to the project. Through definition a micro-credential learning system can 'create pathways that standardize and evaluate competency training as it aligns to regulatory bodies such as Transport Canada and ICAO (International Civil Aviation Organization made up of 193 countries) in smaller achievable tasks that align to workplace activities.' (from CCAA and industry partner report, 2021).

Though this project focused only on *Aviation Inspection Level 2* which had *19 Learning Units* contained in *3 primary Competency Areas*, the full micro-credential framework for this occupational group encompasses 3 Levels with relevant content and competency areas. Such a micro-credential system can be flexible and accessible to the specific needs of a worker, whether at an entry level for new workers or for experienced practitioners. Importantly, given the integration of a digital passbook system to document and certify achievements at specific competency and skill levels, such a learning resource and credentialing system can mirror existing systems maintained by government regulators and implemented in most all apprentice/journeyperson trades and licensing structures.

SECTION 2 Project Stakeholders & Framework

Who were the stakeholders for the program undertaken with FSC? (Table 1)

The following graphic outlines the core framework and process lineage used to develop and implement the core research elements of the project that were intended to test and evaluate this new training system.

At each phase, targeted stakeholders were engaged to contribute to the project elements according to their subject matter expertise or role in the project. Ultimately, the primary target population engaged the research – the testing and evaluation of the digital learning resource – were the workers who had pertinent responsibilities, and related experience, for levels of aviation inspection with their employer.

The following table shows the framework and process elements in relation to contributing stakeholders.

Core Process Element	Stakeholder Engagement
Industry Identification of Need and Objectives	A Project Working committee made up of aviation companies and subject matter experts from the Aviation sector who have responsibilities for various levels of aviation inspection. These companies were engaged to provide comprehensive input to the content developers and creators of the learning resources, occupational requirements and digital training system. Additionally, given the breadth of aviation occupations and specific workforce and training needs within the sector, this Committee was responsible for identifying and selecting aviation inspection classification as the priority for this first project and micro credential.
Confirm Occupation & Skills/Competencies Required	Aviation Maintenance Engineers (AME) who are ultimately responsible for signing the official release of all certified aircraft for use by airlines and are licensed to do so by the national airworthiness authority, were the primary stakeholders to identify and integrate the broad range of competencies and skill sets for aviation inspection so that the micro credential framework and content could be established. These stakeholders were directly engaged in the establishment of the various levels, skill set categories, learning units, lesson plans, information resources and occupational content requirements that pertained to aviation inspection.
Design and Develop Training Content & Standards	The consulting group engaged subject matter experts to provide key input for the development of content, lesson plans and learning units to align with important work-based and adult learning principles. A key activity for this element was the translation of occupational skills and competencies identified for aviation inspection into specific micro credential learning units and the integration of each of these to establish the 3-level occupational breakdown for the full occupation. Further, the subject matter experts were required to interact with the program developers to establish the 'digital' presentation of all the material and formalize the various system elements required to support all activities, navigations, videos, etc., to meet both the skill/competency requirements and the learning/teaching concepts and techniques. The digital logbook was developed in a separate project to track identified skill sets for certification.
Design and Develop digital/virtual Learning Resource & System	The creation and confirmation of the multiple levels of skills and competencies required for aviation inspection was a collaborative undertaking between subject matter experts from industry and technical/technological developers. An independent consultant was engaged to develop the new digital learning resource and who also had experienced aviation industry staff to provide a deeper capacity required for this specialized resource. This group was directly linked to the Working Committee members and the Program Design consultant to form the core development team that built and linked the many resources and content for the micro certification application into a digital environment. This working group established the critical path, development schedule and integration of material into the virtual system. They also held beta testing of the system with a small group of university students to secure feedback prior to release of the test

	version.
Beta Test – Employer Group	A smaller group of industry employees and other professionals involved in aviation and training areas conducted an initial beta test of the full digital training resource. The pre-test offered an opportunity for content assessment, technical calibration and alignment of all resources and systems before full, public testing. Additionally, the system was enhanced and upgraded to meet industry and regulatory levels for accessibility.
Test and Evaluate Content, Delivery, Systems, Benefits	Front line workers from aviation companies across Canada were the primary stakeholders for this research project and who tested the full digital learning resource and provided their evaluation. These workers were employees who had varying levels of responsibility for aviation inspection tasks and duties. Several 'testers' were Aircraft Maintenance Engineer, (AME), designates, others had defined duties that engaged them in elements of aviation inspection leading up to final inspections by a licensed AME. A few AME-level participants participated in a more in-depth focus group session that followed the primary evaluation. These candidates were not only familiar with requirements of aviation inspection and higher-level regulatory responsibilities and authority, but they also brought years of experience and knowledge about all aspects on workforce training, curriculum and content, and workplace requirements. The purpose of the focus group was to address issues identified through evaluation feedback: potential challenges, gaps, resource needs, and enhancements or quality improvements that would prove beneficial.

Table 1 - Stakeholder Involvement

How has the purpose and use of the evaluation been articulated?

Provide details on any work done to articulate how this evaluation's findings were envisioned to have been used by partners, key project stakeholders, and other external stakeholders. If possible, describe any relevant processes undertaken to develop and validate these goals (i.e., design workshops, one-on-one consultations, etc.)

Employers and workers from aviation and aerospace were the key drivers of a new vision for the sector and new direction for workforce training.

They captured their main goal for both the project and the overall context of a new training system for their industry:

> "This innovative program design was created specifically for the aviation and aerospace sector to support highly technical training that is required to become more efficient and adaptive to support the current and future workforce across Canada. In consultation with a consortium of employers and industry partners, the Multi-Skill Training Program was created from best practice research to support cross-functional career progression and modernized training."

The undertaking of this project was a direct result of multi-layered consultations with sector employees and employers focusing of the purpose of identifying new, comprehensive training and certification to support the workforce needs and to address current and pending labour

force shortages.

Separate interim reports were provided to help the industry and stakeholders formulate and form the most cohesive and current knowledge about training for professionals in an occupational group requiring multi-levels of skills and competencies for their job. While there were, and are, many occupations identified within the aerospace and aviation sector that are under the same pressures and require new approaches to this key issue, the industry identified aviation inspection as the initial occupational grouping to target.

Based on planning and consultation with various stakeholders, the industry captured its vision and objectives for the establishment of a new workforce development framework and system that can support the current and changing needs of the sector. These were articulated as the *Multi-Skill Program* for aviation and aerospace and incorporated the following 5 core elements as the focus of development. These set the foundation for this project and first occupation of aviation inspection:

#	**Core Elements of the Multi-Skill Program**	**Description/Details**
1.	National Occupational Standards	• Revised National Occupational Standards combined with the Competency Dictionary to create the basis for occupational profiles. • Basically, each profile provides a map of the competencies needed to pursue one or more components of an occupational standard and its associated career development path.
2.	Competency Framework	• Based on the Competency Dictionary and designed to support cross-functional career progression within manufacturing and maintenance in the Canadian aviation and aerospace sector. • Program takes a systematic approach whereby competencies and performance criteria are defined, training is based on competencies, and evaluations measure proficiency. • Enables industry partners, their employees, and future employees to have defined pathways and customizable learning plans leading to national certification and accreditation across the multitude of occupational sectors. • With the use of micro-credentials, training plans and programs can be used to assess and accredit the functional ability of an individual based on competency, not on time spent on learning.
3.	Competency Dictionary	• Outlines the observable behaviours required for successful job performance of both 34 technical and 16 non-technical competencies. • The competencies defined within the Competency Dictionary, map to job titles, roles, functions and accreditation standards across all 29 National Occupational Standards.

		• Competencies are observable abilities, skills, knowledge defined in terms of observable behaviors required for successful job performance. • Ensures that manufacturing, maintenance, and other aviation personnel will be ready to handle a variety of defined and undefined situations in the workplace.
4.	Digital Logbook (DLB)	• Provides real-time status and tracks overall performance during training. • Both the supervisor/mentor and the learner/mentee use the DLB to provide guided industry non-technical behavioral proficiency standards. • Learner/worker uses the DLB to provide documentation on their progress and mentors verify the completion of practice activities. • All practice activities within the DLB are aligned to the National Occupational Standards, and designed to meet regulatory, licensing and training requirements.
5.	Workplace Learning System	• An important element, it is envisioned that the work setting be the place to learn and be evaluated on the theory components of the program. • A learner/worker will use interactive tools designed to learn new concepts, to practice and to receive feedback on their progress and learning. • Flexible and customized to allow for all parties to focus only on needed skills training. Some may need complete training and some may need upskilling: either can occur during 'flow of work' activities to best match the content to actual task and job duties.

Table 2 - Industry Stakeholder Objectives

"Competency based training (CBT) places emphasis on 'what a person can do' in the workplace as it relates to an occupational standard. It is different from traditional learning in that it aligns to work that is performed everyday. The learner is an active participant that is guided to accurately perform a task to an industry standard and in-the-flow-of-work."

The industry established this key foundation and desire for future training systems that are directly linked and accessible to real activities, knowledge and challenges faced in a work setting. Two key components of this vision were built around the following:

a) Workplace learning is a high priority for the existing workforce and, wherever possible for any occupation, the workplace should be the primary learning center as opposed to third party, classroom engagement. The 'apprenticeship' model for skilled trades across Canada provides a basis of on-the-job mentoring, tracking and certifying practices.
b) Micro-credential certifications represent a certification of assessed competencies that are additional, alternate, complementary to, or a component of a formal occupational credential. They allow for standardizing and evaluating competency training as it aligns to regulatory bodies in smaller, achievable tasks that align to workplace activities.

One of the highest priorities for industry training identified by stakeholders is the ability to have

greater influence and control over the curriculum, content, delivery mechanisms and delivery models. While recognizing the importance of expertise available from third party trainers and educators – both public and private – there are many factors that third party providers are not mandated or able to keep current. Among these are factors critical to industry: technology, capital equipment, and the ability to react to changes in regulations or production methods. Upskilling the existing workforce is determined by actual work-related activities, and many companies cannot afford or access the ongoing, customized training responses required in a timely manner.

For these reasons new models such as Multi-Skill Training Programs and the use of digital training resources formed the basis of this Micro-credential project. It will also allow future systems to have far more capacity and capability to meet changing workforce needs across the industry.

This overarching, longer term goal to establish training systems that are more work-based in both content and delivery, and more industry managed and operationalized than present systems, was expressed by the industry in the following chart that compares Competency Based Learning to Traditional Learning:

	Competency-Based	**Traditional**
Goal	Application based	Knowledge based
Mentor Role	Facilitate skill acquisition	Deliver information
Mentee Role	Active participant	Passive participant
Assessment	Emphasis on feedback to improve performance and objective	Emphasis on testing and content and subjective
Learning	Guided by performance	Guided by lesson plan or book

Why was this project needed?

- Who are the populations that this project aimed to serve (be as specific as possible about demographics, geographical locations, occupations and sectors)?
- To what extent were these needs being addressed before project implementation? What was known about what needed to be improved and/or expanded?

As identified in the latest CCAA national report on the aviation and aerospace labour market, the sector directly employs ‘154,000 workers and would need 55,000 new workers by 2025 to keep pace with the projected growth and replacement demand (retirement & leaving workforce)’. Nationally, the training system can supply up to 14,000 workers from secondary and post-secondary institutions, leaving an approximate 41,000 worker supply gap.

Several key challenges and impacts have led to today’s workforce issues and provide the impetus for this project. According to industry research findings, the following priority issues require new and revised training systems:

1. Shortages of workers in key occupations are compounded by a growing gap between the

skills of PSE graduates and skills industry needs, due in part to rapid technological advances.
2. A technological gap between the equipment used in educational training and that used in the modern workplace.
3. The challenge of business finding qualified workers or finding an adequate way of upskilling existing workers for new technologies or to accommodate new lines of business.
4. The need for the sector to adopt and adapt more 'work-integrated learning' options and systems to integrate new workers and upskill existing ones while maintaining compliance, productivity and competitiveness.
5. A top-priority need for training initiatives that support inter-generational learning – from experienced workers to new workers of all types. Companies need to address succession plans for their workforce internally, while the industry as a whole needs to adopt strategies to educate and train the new generation. Each generation has a different learning style, motivation, and comfort level with new and merging technologies.
6. Importantly, in the realm of aviation careers, the need for pilots in aviation operations has always been a high-profile focus. However, there is a continuous need for critical workers in mechanical, maintenance and technical skill occupations. These Maintenance, Repair and Overhaul, (MRO) occupations are not high-profile, but no less essential than pilots. The focus of this project on the skills and competencies of aviation inspection – as selected by industry – represents one piece of the larger puzzle to target and develop new training and workforce development solutions that can address shortages across all size companies, geographies and many occupational categories.

SECTION 3 Research & Participants

The following charts and information related to the main stakeholder group demographic for the project, that being those who tested the digital learning resource and completed the evaluation. They provide an integrated assessment of both the key participants and their specific background in relation to the research focus of aviation inspection, experience and job/occupational training.

In total, there were 8 unique companies from across Canada who were involved in the research. All companies had responsibilities pertaining to aviation inspection of some degree and level. The participants were all identified, or self-selected, as currently having inspection duties and, for all participants, had been engaged in related tasks for a period of time either with the company or at another employer. From this group of companies, their head office or main facility were located in 5 different provinces and one territory.

There was a total of 38 participants who were screened and registered to participate in the project. All completed the registration package which included the terms of condition of their involvement and a waiver regarding use of a photo. Of the total registered, 34 were able to complete the full research elements that included testing of the digital learning resource and culminated in the evaluation survey. One participant dropped out through the process. The project anticipated and allowed for a range of 30-50 participants due to scheduling requirements and compensation budget provided, so the final amount engaged was able to meet the expected rate.

The following charts are of primary demographics of the participants and presented to provide foundational data on the research group.

Participant Age Groups (Chart 1)

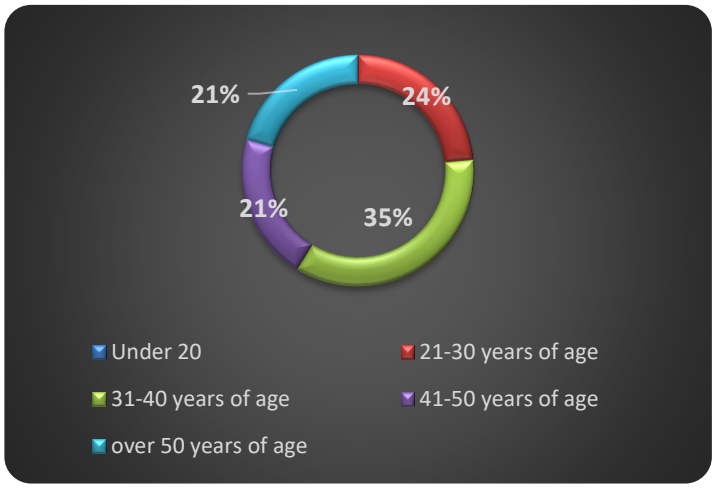


Chart 1 - Participant Age Groups

Under 20	0
21-30 years of age	8
31-40 years of age	12
41-50 years of age	7
over 50 years of age	7

Years in Current Position (Chart 2)

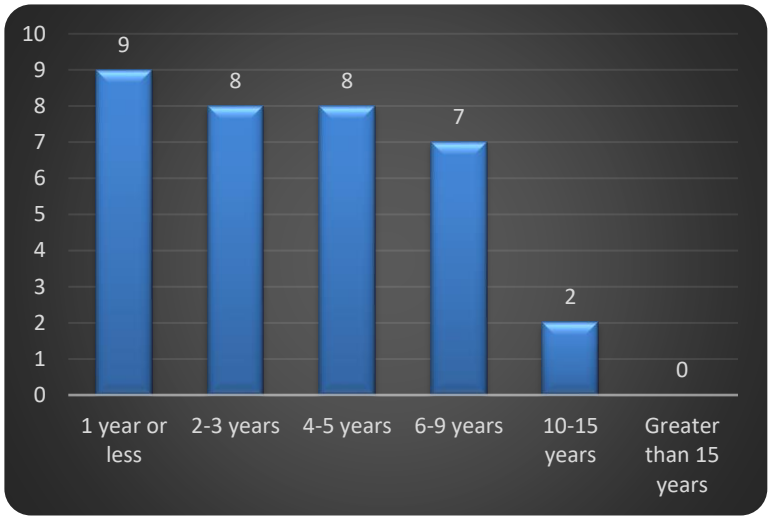
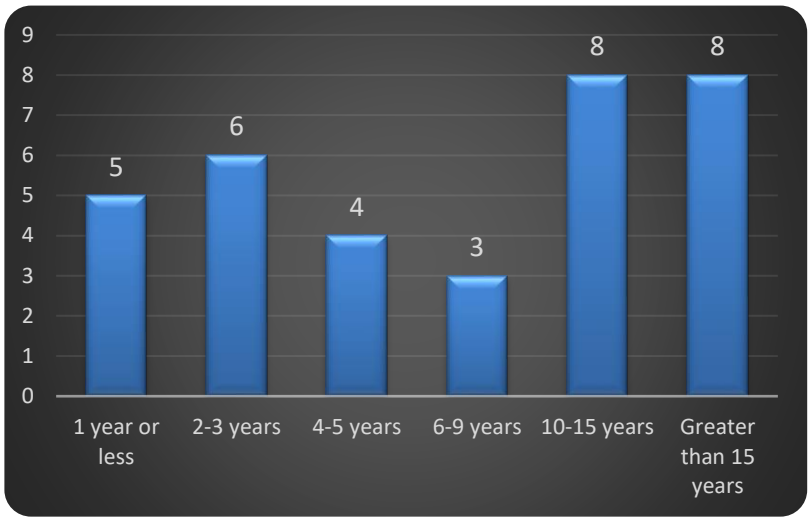


Chart 2 - Years in Current Position

1 year or less	26%
2-3 years	24%
4-5 years	24%
6-9 years	20%
10-15 years	6%
Greater than 15 years	0%

Years Working in Aviation or Aerospace Sector (Chart 3)



1 year or less	15%
2-3 years	18%
4-5 years	12%
6-9 years	9%
10-15 years	23%
Greater than 15 years	23%

Chart 3 - Years in Sector

Previous Use of Digital Systems for Job Training or Employment (Chart 4)

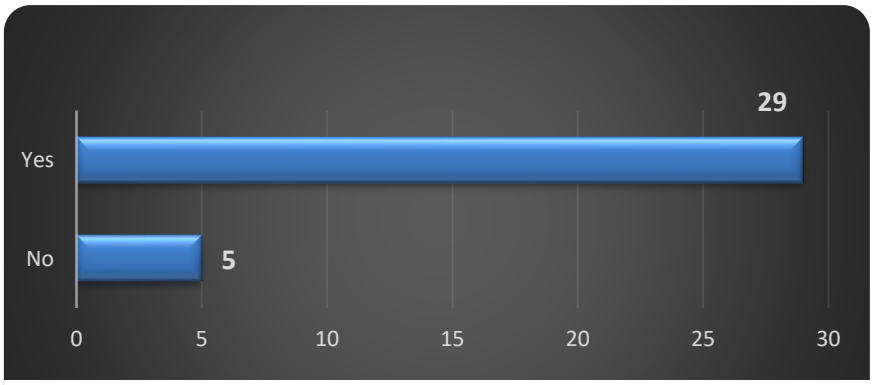


Chart 4 - Previous Use of Digital Systems

The focus of this question was to gauge their previous experience of the participants in their use of online, digital systems. Developing digital learning resources is linked toand dependent on many factors, and some important elements to consider include: age of users, level of education or experience, and complexity of the material being presented. What was important for this project is that users were not at a basic level of technical or occupational skills, and nor was the system built for basic or introductory purposes but was targeting users who already had key awareness and knowledge of the complexities of aviation inspection. As noted, 29 of the 34 have used digital learning systems for their occupational field and training.

What was being tested in this project?

The type and number of digital learning resources available to the population is rapidly expanding. It is no longer a debate as to whether digital learning should be a key tool in delivering education and training to an audience - in fact, it's a necessity – but to be successful now leans towards the important focus of how to ensure the resources created are effective at meeting learner needs and the specific occupational, sector and even individual company

needs.

Key to any digital learning resource ('system') is being able to answer the question: does it deliver on the core purposes of teaching and developing skills that will be useful and applicable? Many digital resources and tools exist and are accessible to the general public, some for specific professions and occupations, but ensuring they meet a required and 'lofty' objective of addressing the skill and competency needs underlines the need for purposeful and targeted evaluation.

While more prominent in the areas of educational institutions and teaching environments – of which many industries are reliant for their future workforce – there exists a significant need to ensure that digital learning resources are developed, adapted, and integrated into the private sector of employees and workers from all industries. While Kirkpatrick and others have highlighted important objectives and outcomes of digital training for workers as a premise and foundation for achieving corporate goals and success, there remains a void in the capacity of industry sectors to mount the types of digital learning systems across multiple levels and professions to ensure that learning and skill outcomes are understood, addressed, and measured.

LEVEL 1 - *Reaction*	The degree to which participants find the training favourable, engaging and relevant to their jobs.	Primary Focus of Project
LEVEL 2 - *Learning*	The degree to which participants acquire the intended knowledge, skills, attitude, confidence and commitment based on their participation in the training	Primary Focus of Project
LEVEL 3 - *Behaviour*	The degree to which participants apply what they learned during the training when they are on the job	Future testing options for companies & workers
LEVEL 4 - *Results*	The degree to which targeted outcomes occur as an outcome of the training, support and accountability package.	Future testing options for companies & workers

Jim Kirkpatrick: 'An Introduction to the New World Kirkpatrick Model'; Sept 2021

Building on the techniques and models identified by various academic and educational bodies to establish evaluation tools that can capture and assess a digital resource within the key framework of 'usefulness and effectiveness' for learners and companies, researchers for this project integrated elements that allowed for a foundation of information and knowledge to be gained. Noting the earlier chart by Kirkland that highlighted 4 key levels of training intervention and objectives, it is important to reinforce that this project was not purposed to align with any individual corporate objectives or to measure skills and competencies gained by a participant against such corporate indicators or targets.

Nonetheless, a continuum of testing and evaluation was established by assessing the digital learning resources as it relates to the learner ('worker/employee'). The next significant

research goal that would follow for employers would be to evaluate the ability of learners to apply their skills and knowledge to meet their unique job requirements, to meet any professional/ occupational standards, and to align where pertinent to overall industry need for building and maintaining qualified workers within Canada.

Drawing upon some recognized evaluation frameworks for digital learning resources from *International Journal of Computer Science Research and Application* (*Vol 3, Issue 3*), and *International Journal of Emerging Technologies in Learning* (*2015*, *Abderrahim El Mhouti et al, - Faculty of Sciences*), the evaluation elements of this project attempted to examine, highlight and measure some the key aspects and outcomes of the digital aviation inspection system and micro credential learning resources being tested:

1. Technical Quality

   The focus for evaluation of the technical quality involved a variety of key elements related to the overall system and the technical components used in a range of learning units. Effective technical aspects are the foundation of a system and will lead to the ability, or not, of users to access, use and achieve the learning outcomes inherent in the activities. Evaluations for this element focused on: design (content, organization, visual context to support interactivity, graphics and design for aesthetic presentation and usage, images and illustrations used to assist learning); browsing (ability to manipulate and use resources, ability to identify and locate relevant content, clear presentation of material, groupings and ability to choose, formal and user-friendly menu's, dashboard, indexes and overall content groupings); Creativity/Ingenuity (the use and capacity of multimedia technology, animation and animated images, effective text and graphics for clarity and purpose, ability to use multiple screens/windows as relevant).

2. Learning/teaching Quality

   These elements of the evaluation focused on the role of the digital resource in assisting and aiding learning activity, and provide the support for learners to gain knowledge and greater competencies for their role. Key evaluations for these aspects include: methods (use of varying ways to introduce information to users, interact, supportive to differing learning styles); activities (enable learners to manipulate or compare content, use of various feedback options such as exercises and tests, relation of activities to real world issues, situations and solutions faced, aligned with the requirements and tasks of the occupation/skill requirements).

3. Academic Quality

   The evaluation aspect for these areas focuses on the quality of the information presented in the digital resource. Key areas measured included: reliability (accuracy of information presented and error-free, consistency across learning modules, sourcing and confirmation of content as required); relevance (is information current and effective for learner requirements, is it usable and applicable, does it support learner gains in information and application).

To the extent that these primary elements of this evaluation framework are sufficiently recognized for being robust in assessing digital learning resources, the focus of the evaluation questions were targeted at the training participants who actively used the full spectrum of resources and then completed a full survey that was built in respect of securing feedback within the framework.

For the project, an e-learning rubric (see Appendices) was established as a guide to the overall framework for evaluating the digital learning resource being tested and to help focus on the

important training and learning elements that should exist in robust systems for user success. 'E-Learning' tools are defined as any digital technology, mediated by a computing device, deliberately selected to support participant/student learning. The rubric captures a multi-dimensional context that considers functional, technical, and learning aspects associated with eLearning Tools.

The rubric does not identify a discrete threshold that an eLearning tool needs to cross before a tool should be used. It is intended to confirm the relative strengths and weaknesses of an eLearning Tool, as evaluated by the users/learners who will be testing and using the tool.

Last, the evaluation of most digital learning resources often involves assessment of the 'pedagogical' aspects – teaching and instructing – of the material and system. While this is primarily understood as being related to the capacity of the resource to support instructors in the delivery of materials and learning by use of various methodologies and to integrate differing learning styles, it can also be linked to the resource itself from a 'self-directed' learning perspective. This aspect would center on the ability of the digital resource to enable learners to utilize different elements and resources in different ways to promote their learning and skill development.

One aspect of this is the evaluation of the digital resource to adopt and deliver various teaching and learning strategies and methods. From the design and use of various learning activities and techniques to the integration of teaching approaches and education/learning models, the research elements of this project's scope did not focus on this element.

The project did engage a qualified consultant in educational technology and learning program design who was experienced in pedagogical content for learners. This experience, in conjunction with the technical and occupational expertise from industry who are responsible for training and certifying the skills and competencies of those in aviation inspection roles, provided a solid framework for the design of the learning units, lesson plans and all resources and activities integrated in the digital learning resource.

Given that most 'testers' (project participants and users of the system) did not have the requisite backgrounds or experience to evaluate the pedagogical models and techniques established, the researchers did not focus the evaluations on these aspects. Future research should consider the evaluation of these principles and resources used as per the *Level 3 and 4* identified in the Kirpatrick model chart from above and with a focus on 'action research' methods that have direct linkages with both experienced and new workers as users of the system to assess effectiveness of the different principles engaged.

Outcomes: What did project partners anticipate as the result of delivering the project as planned?

- Individuals (people participating in a project/intervention)
- Institutions (changes to an organization's ways of working, organizational policies, practices, or approaches)
- Systems (larger changes in the surrounding context, policy change, networks)

This project was the culmination of significant industry and employer engagement over recent years that focused on: the breadth of labour force and workforce matters for the sector; ongoing

analysis of labour market; quantification of workforce demand and supply, and targeted industry committees working with CCAA and partners to affirm needs and priorities and formulate strategies to address important gaps and challenges.

From a macro level view, the industry and stakeholders involved in aspects of training, education and workforce development establish some primary objectives for the project. The following table outlines the stated benefits and goals of the training and the pioneering opportunity that a micro credential framework can offer various stakeholders.

Companies	• Increase AME workforce availability to mitigate expected medium-term talent shortage • State-of-the-art education and trianing tool for efficient on-the-job and in-house utilization
Individuals	• Simplied 24/7 access to digital training and educational assets • Reduced need for relocation and financial assets to support career choice
Communities	• Enhanced inclusion of underrepresented groups (e.g. First Nations, Women, Veterans) • Increased availability of previously less attainable AME career path
Regions	• Ongoing connection between high-tech industry and local population • Increased economic benefits due to decentralized education and training activities
Canada	• Enhance social and economic justice through equal access to AME career path for all citizens • Maintain global competitiveness of Aviation & Aerospace Industry

Table 3 - Benefits of New Workforce Training

Further, CCAA - the only nationally recognized certifying body representing the aviation and aerospace industry in Canada – and industry partners have identified in-the-flow-of-work micro-credential training as an important part of the training ecosystem.

The CCAA is also leading the development of e-learning for maintenance and structures technicians using many of the lessons learned from this project.

The overall benefit of this type of training is the cost effectiveness, the flexibility of when and where learners can engage with the training and the ability to adapt curriculum to employer needs.

SECTION 4 Research Analysis (Reaction)

Effectiveness (Outcomes): What did we learn about the outcomes of the intervention?

Individuals, institutions, systems

As was implicit in the overall evaluation and findings from the evaluation, there is strong and significant desire and appeal by those seeking and needing training to have access to this digital training resources and corresponding aviation inspection learning.

The project's evaluation framework was driven by the overarching context of it being focused on a new digital learning resource. The comprehensiveness and complexity of assessing 'outcomes' was limited to the first 2 levels (restated below) of effectiveness noted earlier when measuring 'outcomes'. The future use of this digital learning resource by companies in a real-world environment was not an element of this project but, if adopted, should be further evaluated to affirm the indicators and factors which support the range of workforce training needs and how this system both integrates and empowers companies and their workers to gain advantages.

LEVEL 1 - *Reaction*	The degree to which participants find the training favourable, engaging and relevant to their jobs.	Primary Focus of Project
LEVEL 2 - *Learning*	The degree to which participants acquire the intended knowledge, skills, attitude, confidence and commitment based on their participation in the training	Primary Focus of Project

While the term 'complexity' was used, it is both appropriate and relevant to the research framework and elements being evaluated. The project was focusing on a significant 'triage' of impacts and elements that were integrated to support a new training and learning system and approach, each significant unto itself but making the 'whole' much more critical than each individual part. This triage included:

1. Creation of a new micro-credential training and certification model designed for an occupational group and recognized, standardized skill and competency levels.
2. Establishment of a new digital learning resource and system that is accessible, robust, and comprehensive that can support independent learning for workers and workplace integration or 'in flow of work' based instructing and training.
3. New occupational training resources, curriculum and multi-level learning units that will meet the industry skills required for workers and learners at varying levels and which allow for an system of validation, certification and national recognition.

The following charts and analysis target the evaluation focus for Level 1 – *Reaction* framework**,** as per the overall context of assessing digital learning systems. To qualify, all participants were engaged in varying degrees with responsibilities related to aviation inspection for the sector.

Were Descriptions of Units & Lesson Plans Easy to Understand? (Chart 5)

An important element of all 'learning' materials is to ensure accessibility and comprehension by users who will, essentially, be self-directed in their engagement.

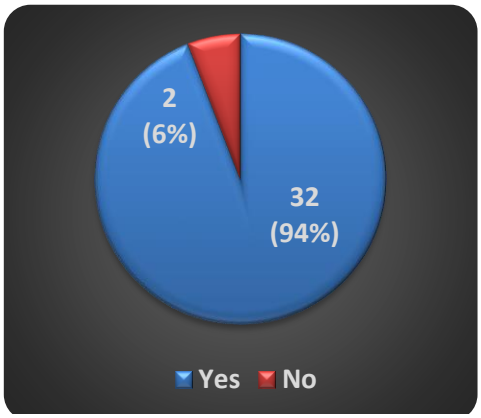


Chart 5 - Clarity of Lesson Plans

Participant input was highly positive on the ease and general grasp of the guiding descriptors for the various Units and Lesson plans used. Securing 94% for clarity of learning documents and resources confirms a solid foundation for the primary content.

To enhance learning and enable the learner to gain knowledge, a digital learning resource must be developed to support and encourage active and learner-centered systems that promote the development of skills.

Were the Learning Objectives Clearly Stated for Each Lesson? (Chart 6)

Still achieving over 90% in a key area that assists learners to understand the focus and intent of the lessons and learning goals, the result reinforces the robust and healthy status of guiding material targeting learners.

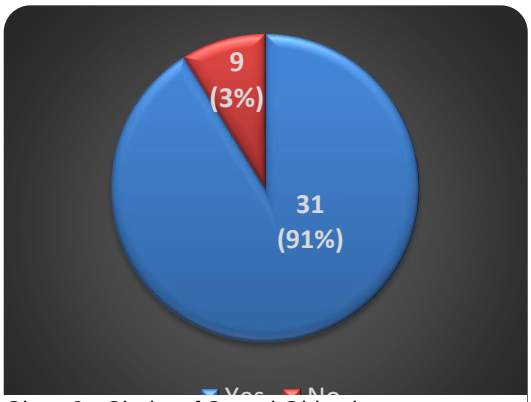


Chart 6 - Clarity of Stated Objectives

Digital learning systems must be able to concisely state the goals and objectives for specific components and, for an outcome, evaluators (and learners) must be able to judge and assess that the objectives have the right purpose, are achievable and capable of being measured. In other words, do the outcomes anticipated meet the stated objectives for the material being presented.

Results from learners indicate a high clarity and delineation of the objectives for the numerous lessons, and developers should identify any potential areas that require attention given that nearly 10% felt otherwise.

Satisfaction With Content Provided in Each Unit (Chart 7)

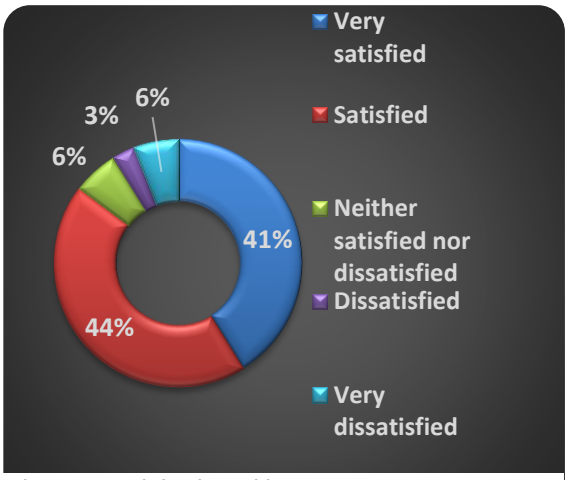


Chart 7 - Satisfaction with Content

Combined, the categories of ‘Very’ or just ‘Satisfied’ amounted to 85%, a solid indication that the important content for this new aviation inspection curriculum met much of its goals for imparting relevant and important information.

There remains some focused verification and validation work to be completed to address the participant input in respect of nearly 10% feeling ‘Very’ or just ‘Dissatisfied’.

In conjunction, a further 6% rated neither, but developers should consider that this rating identifies some improvements to be able to increase the participant satisfaction levels overall.

From a content perspective, participants were asked to identify any information within various units that they felt were missing or could be included for greater comprehensiveness.

The majority were satisfied with the existing content and noted so in comments, the following is an encapsulation of responses that developers could review for future incarnations of the training resources and content:

- A more detailed approach on how to read micrometers, calipers, etc.
- The video with the principle of operation of some parts was not enough for a better understanding of the process of their work.
- To enhance the learning experience, I believe incorporating more visual assistance, such as examples and illustrations, would be beneficial.
- Training did not include any rotary aircraft equivalent topics and was geared mainly to larger commercial aircraft.
- Presentations can be made more interactive
- Some images can be replaced with real photos.
- Information was sometime not fulsome enough or oriented on a specific type of aircraft and doesn't apply to other type of aircraft.

Participants Who Felt That Some Topics or Training Information Were Missing (Chart 8)

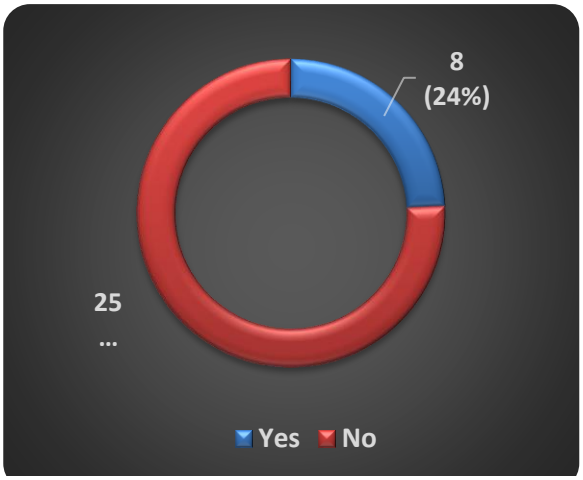


Chart 8 - Any Missing Information

A solid number of participants - 76% - felt that the overall framework and key elements covered was comprehensive and sound.

As in any new endeavour with the complexity of creating learning resources that can align and match with the occupational requirements and the unique situation of each learner, there is an ongoing need for 'quality assurance' practices to refine and align resources and materials to required standards. This project set the initial bar and hit many marks.

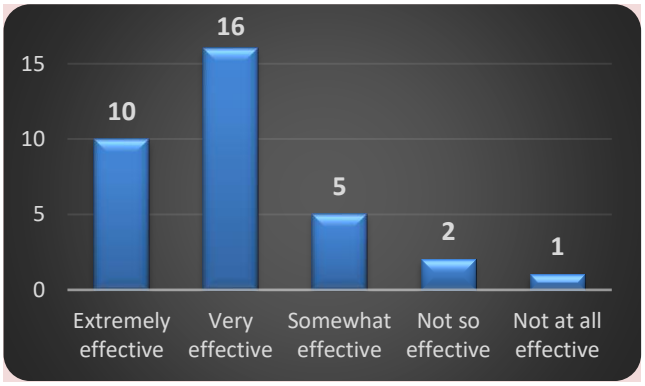
With 24% identifying that some topics or information were missing, it reinforces a goal of establishing an ongoing feedback loop that targets the core training materials and resources utilized.

Information reliability lies in credibility and accuracy and being error-free – Is this accuracy sustainable over time? Such evaluation of instructional design involves an examination of its goals, objectives and teaching strategies which, for the most part, participants were very positive in their assessment with the proviso that there can be no substitute for accuracy and comprehensiveness when trying to meet critical standards for skill and competency resources.

Rate the Structure and Order of the Lessons (Chart 9)

Ensuring that the sequencing of materials is effective and builds on the learning path for users is an important principle of any teaching protocol. A critical element is structuring and 'step-laddering' the learning curve so that information is presented and shared to support learning growth and not be misaligned and therefore confusing to a learner.

Especially within digital learning systems, effective and appropriate instructional strategies lie in designing and organizing learning activities based on techniques, methods, approaches and activities that support learning styles.



Extremely effective	29%
Very effective	47%
Somewhat effective	15%
Not so effective	6%
Not at all effective	3%

Chart 9 - Order/Structure of Lessons

For these important elements,76% of participants found that the order and structuring of the main learning content was Very or Extremely Effective, with a further 5% noting it was Somewhat Effective, for a total of 81% on the positive scale. Though small, 9% of respondents felt that there were weaknesses in the order and structure and for which more detailed investigation is due and, again, affirms a goal of a formal feedback loop be established to have an effective protocol to revise and improve all areas of the overall digital learning resource.

Ratings of Design, Layout, Visuals, Accessibility (Chart 10)

Critical to all digital learning resources is the overall 'user-friendliness' across all levels and content. By its nature, it represents and presents the physical classroom for each learner who not only must focus on content but also learn, manipulate and navigate the full environment to aid their learning.

As reinforced in current guidance for digital learning, the system construction must be sound to ensure the structure of the digital learning resource promotes its intended purpose through such elements as appropriate interactivity, logic of organization, ease of orientation (e.g. summary, dashboard, site plan), ease of browsing (back-and-forth, scroll box) and readability of pages. Many systems adhere to established accessibility standards, and many also provide controls to allow for individualizing some interactive settings (font size, background colours, language)

For more information about usability, participants were also asked to provide any input about features that would improve the content or was missing from it:

- More animations to keep the user more intrigued.
- The print and font could have been bigger and bolder.
- In most of the pictures, the item description appears too small.
- The use of animation in some of the complex learning objectives would be very helpful.
- Units could follow the same order: overview, introduction, content, quiz, etc.
- More interaction within modules/lessons with diagrams.
- More practical examples, using animations to explain flow of the air, oil, fuel.
- Would like if all the units had the same "readers". Some voices sounded too "robot like".

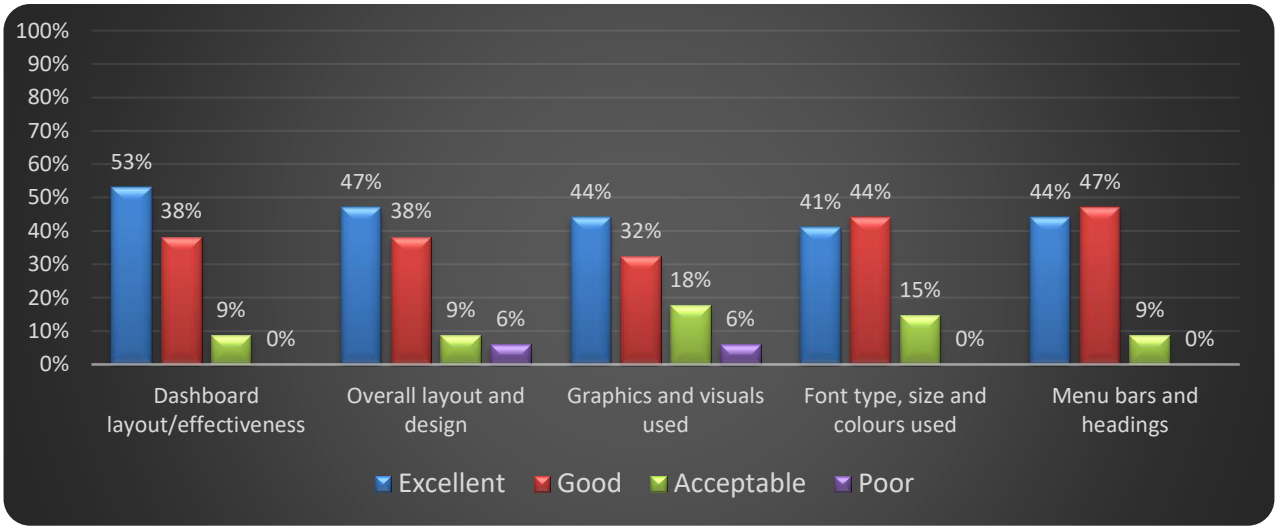


Chart 10 - Assess Design/Layout/Accessibility

The project evaluation measured a range of system ‘design’ elements and secured responses from all users for key areas. In all five of the main elements assessed, the Excellent or Good ratings ranged from 76% to 91%, placing it on solid ground for its overall usability and learner driven accessibility. In total, only 6% of participants found 2 of the categories as being poor, followed by the Acceptable category coming in the range of 9% to 18%.

Linked to this, participants were asked to specially assess the general navigation through the broad system and utilization of the learning resources. Very positive feedback of 32 of the 34 participants noted that they found it Very Easy or Easy, and no one noted having any difficulty.

Rating of the General Navigation Through the Platform and Resources (Chart 11)

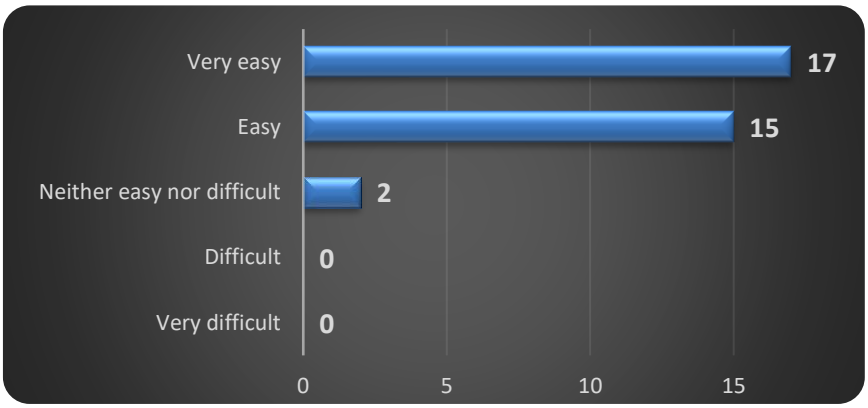


Chart 11 - Navigation of System

The previous evaluation focused on the micro level of 'user-friendliness' and general accessibility and effectiveness, while this question had overall navigation across the platform and numerous resources.

Some of the elements of *navigation* that come into play for digital learning resources include items such as ease of browsing, multi-page engagement, menu selections and indexing, page scrolling to name some.

Badge for Full Unit Completion - a Beneficial Way of Recognition? (Chart 12)

Unique to the system and, perhaps, the occupational group, an element of recognition and reward in the form of a 'badge' to knowledge successful completion of key skill and competency levels was included for feedback. In line with some apprenticeship and/or mentor-type systems of training to a standard, achievement of a badge would include successful completion, no failures, and certification by an approved supervisor level qualified by way of their own license or certification and by the sector and company.

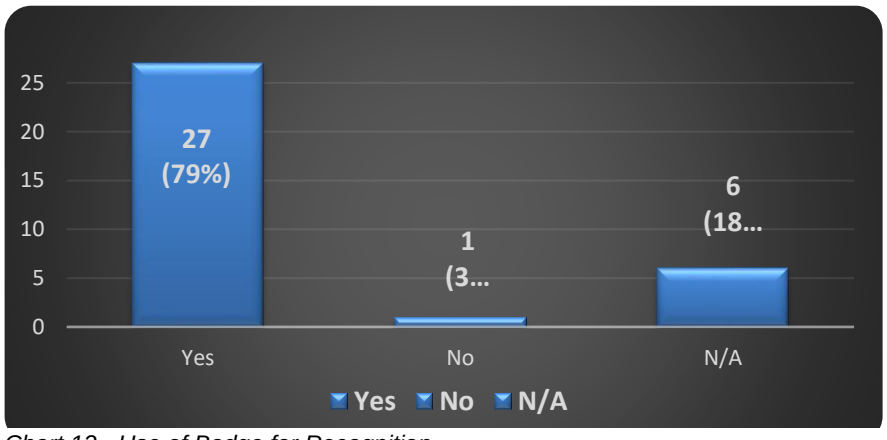


Chart 12 - Use of Badge for Recognition

Most participants found that an official, sector and skill based 'badge' of some form was a positive element to include.

Part of establishing a sector wide and occupational classification system of approved standards will involve some type of integrated method to aid in rating, scoring, tracking and confirming achievement against a set level of industry and occupational competencies. The scoring badge option included should be further developed and endorsed by industry once the overall levels and evaluative mechanisms are refined and implemented.

Participants Who Experienced Any Technical Difficulties (Chart 13 & 14)

The stability of any digital system is significant for many reasons, especially in the context of business training when time and productivity come into play. The following two evaluation areas looked at some basic elements related to the general performance of the system.

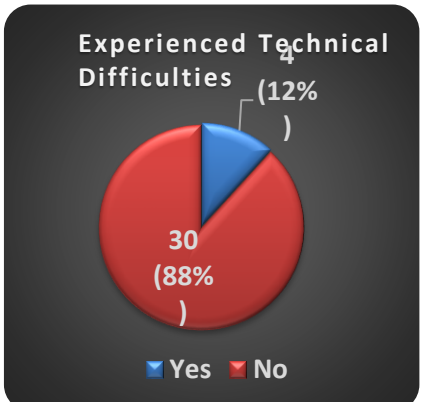


Chart 13 - Any Technical Difficulties

The positive outcome is that the majority of participants, at 88%, had no issues in regard to the system operating effectively for them. Most of the participants used a laptop system to take the training, either home or work based, and a good number also used their cell phone and the developed application to use the system. The results indicate that there was excellent stability and technical integrity for users who were provided various options for access. This bodes well when systems offer a good range of technical options for adult learners, taking advantage of the current technology to support access in a flexible manner.

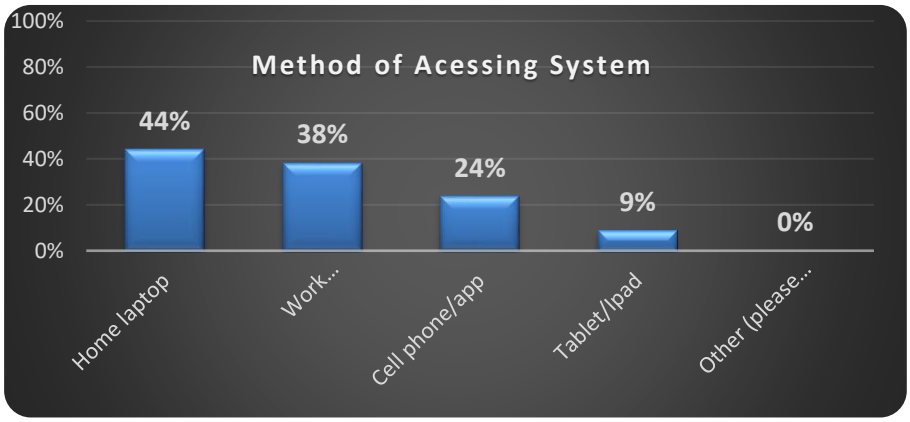


Chart 14 - Method of Access to System

While participants were asked for any additional comments on technical issues for clarification, there were only a few provided and which included: couldn't access the workbook from a work laptop; in some units the presentations would 'flicker' and sometimes go dark. This is likely an issue of bandwidth and is a lesson learned for minimum technical requirements.

SECTION 5 Research Analysis (Learning)

The next charts and analysis relate to questions and participant input for ***Level 2 – Learning*** framework. These elements represent the key essentials when it comes to digital learning resources and adult learning concepts.

At the heart of the matter, digital learning resources balance themselves between the effective use of technology and technological attributes and the effectiveness and benefits required of any learning resource and material, essentially having to answer the questions: *Do these products really carry out their main purpose of teaching and developing skills for learners?*

The evaluation of digital educational resources is not always a straightforward or simple exercise. Effective evaluation needs to incorporate key aspects of both the 'system' and the 'content' in relation to a set of agreed upon criteria for measuring effectiveness. Most important is the audience or subject upon whom the evaluation will fall, that being for most digital systems the 'user'.

For this project, that stakeholder was the employees involved in aviation inspection. However, the content for the system required the expertise of both licenced and experienced workers at the highest level who had requisite credentials and who were working alongside those with knowledge of adult learning practices and principles. Combined, they had to turn the 'vision' and resources into a new digital environment that supported all facets of skill development.

The project was not focused, or intended to focus, on what *Kirkpatrick* has rightly identified as critical to 'company' success – therefore, it did not engage corporations and their mandates, targets or business plans across varying companies that require skilled aviation inspectors to fulfill such corporate goals.

Participants Who Achieved New Learning from The Lesson Plans (Chart 15)

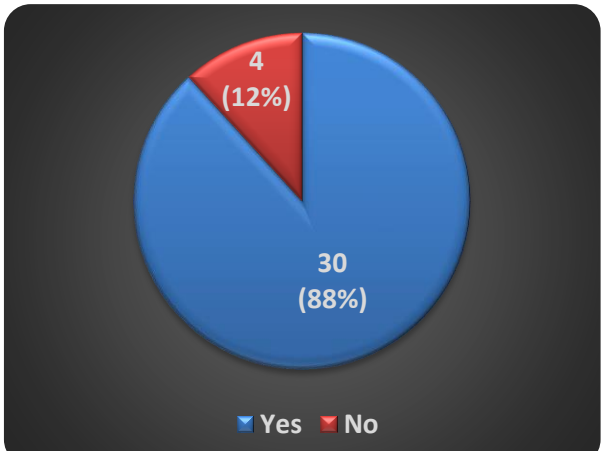


Chart 15 - Achieved New Learning

Given that 88%of participants identified they secure new learning from the lesson plans and resources confirms its ability to meet a significant range of individual skill and competency levels. Further, given that 34 participants tested the system, all with individual learning styles in the broad scale, it is a positive reflection that the digital learning resource has encompassed and delivered varied techniques to support adult and work-related learning.

How Beneficial Were the Assessments/Tests/Quizzes to Feedback? (Chart 16)

Chart 16 - Benefit of Learning/Feedback Resources

Extremely helpful	35%
Very helpful	32%
Somewhat helpful	21%
Not so helpful	6%
Not at all helpful	6%

When we looked more deeply into the Not at All Helpful ratings (2 participants), we saw that

both responses came from individuals who were of a high experience level and had worked in the sector for 10-15 years. By contrast, of those who rated these elements as Extremely Helpful, 60% of these respondents (12) were from the category of 1 year or less of experience in the sector.

While this result makes intuitive sense from the perspective that experienced workers may find the tools less helpful in assisting learning as they are more advanced, but also the fact that the exercises and project were focused only on Level 2 of the micro-credential for this occupational training and, hence, may not have been adequate for those who would be at Level 3. A more precise review would be beneficial, but overall 88% of responses were positive on the existing tools to help learners gain knowledge and competencies.

Participants Who Felt Work-Related Skills Improved After Using Learning System (Chart 17)

A significant number of participants – 82% - noted that their existing skills had directly improved because of taking the training.

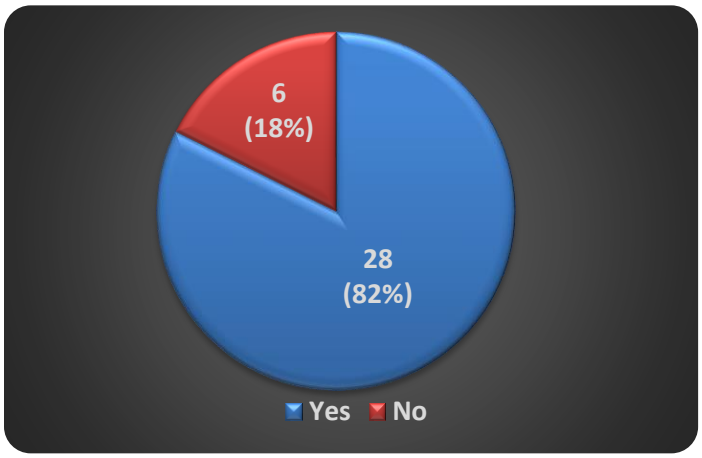


Chart 17 - Skills Improvement Assessment

A Micro-Lesson will ideally include everything a mentee needs to learn, understand and to apply new skills. Each Micro-Lesson in the digital learning resource and occupational framework was self-contained, and the participants had access to multiple self-directed activities.

This evaluation aims at the centre of focus for enacting any digital learning resource, that being to help learners 'gain' and the 'apply' their knowledge in a successful and pertinent way.

Project participants have confirmed that these skills gained were directly linked to their work-related duties and being able to employ new learning for these responsibilities.

Participants Able to Apply Their Learning in Their Work Situation (Chart 18)

While utilization of a digital learning resource can increase and improve numerous elements related to self-directed learning and skill development, both employers and employees are most interested in the conversion of the learning to the requirements of their occupational requirements and their work duties.

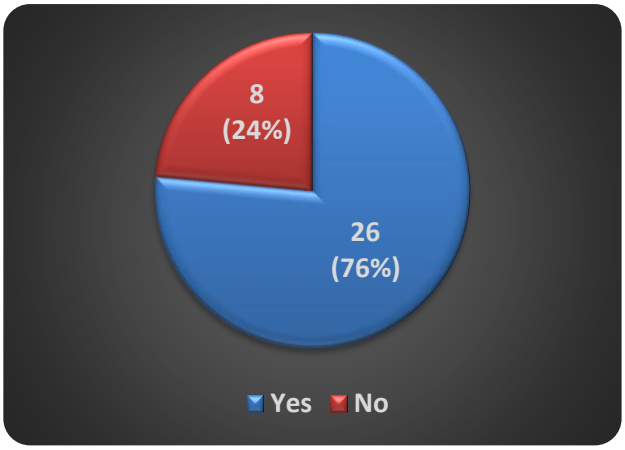


Chart 18 - Able to Apply Learning

An important evaluation area, transference of knowledge gained into practical action and application to a real-world situation underlines most all work-related training goals. The project participants evaluated this key process and 76% identified that they were able to apply learning to their work situation, a significant achievement for this new system and resources.

A further 24% noted that they were not able to apply their learning. While various factors and rationale may have impacted this – from lack of opportunity to apply skills to limits of the material – the response does warrant some further review given that the core purpose of the digital learning system is to empower and aid workers to learn and apply knowledge towards their work.

Benefit of Learning & Skills Gained to Help Advance In Job or Career (Chart 19)

A total of 88% of participants identified that they found the skills learned from their training would have a beneficial impact on their current job and/or career development. A solid 65% rated their benefit in the highest 2 scoring categories. This 'value added' rating outcome for individuals provides a strong consensus on the overall ability of the system to meet the direct and current requirements of the occupational category and individual employment situations.

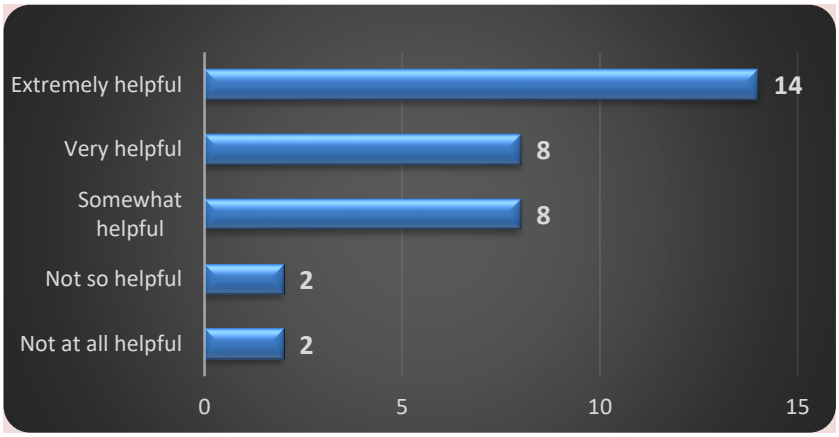


Chart 19 - Benefits for Job/Career Growth

Extremely helpful	42%
Very helpful	23%
Somewhat helpful	23%
Not so helpful	6%
Not at all helpful	6%

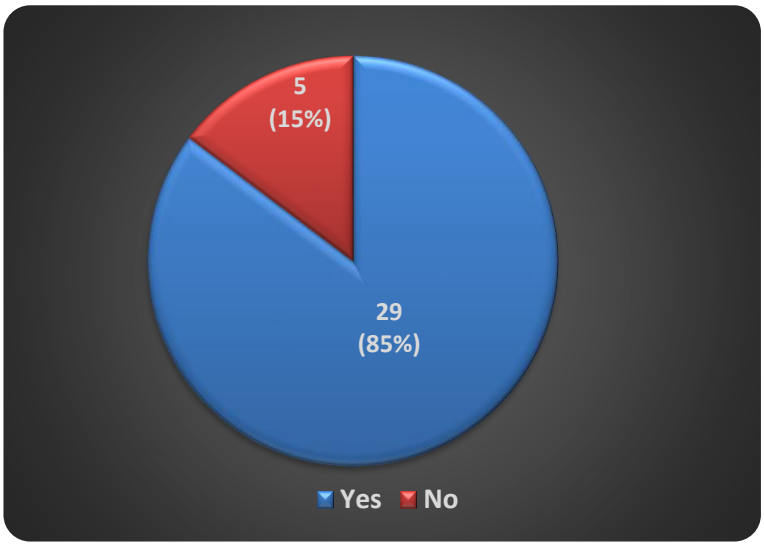
Pertinent to the evaluation framework for the project in relation to the goals outlined form both 'Learning' and 'Reaction', responses provide firm confirmation that the overall content and learning resources have shown effectiveness in a pilot study and which should lead to solid benefits in the future for this occupation and methodology. Its direct usefulness is quite evident and with some added clarity that it can assist workers in their duties, offering the direct benefit to employers by default.

Did the Course Meet Professional or Occupational Requirements? (Chart 20)

Another important litmus test for any learning resource and its content is the relation of the training to a specific occupation and, within that, the requirements placed on it by internal (e.g. employer) or external parties (regulators).

Participants were asked to assess if the overall course and content met with their professional or occupational requirements. As Aviation Inspection is not a designated profession that requires a formal license or regulated certification, the primary training content will be driven by a common, agreed upon set of standards as determined by the industry. This control and responsibility are positive for the industry for many reasons.

The challenge is to ensure that the core content and training resources are aligned to support the central skills and competency areas needed by all field workers balanced with the fact that some uniqueness experienced by individual companies or sub-sectors may have to handled separately. A premise is not for the industry to meet every requirement in all technical and employment situations faced by companies, but to ensure the highest level, mandatory and most critical content is provided.



Given this future opportunity for the sector, the respondents have provided very positive confirmation that the existing training curriculum and overall learning resource is able to address the immediate standards of the occupation for those working in this field. With 85% affirming that the content has met their known and professional requirements, the solid groundwork has been established for the Level 2 content used in the project.

Chart 20 - Course Met Professional Requirements

Interest in Taking Other Courses on a Digital Platform (Chart 21)

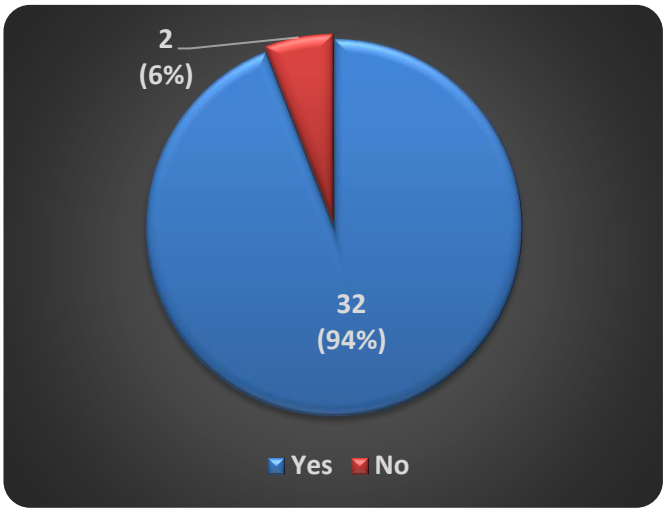


Chart 21 - Interest in Future Digital Courses

Responses to this question bode well for the development of additional occupational groups and/or similar training programs. With 94% confirming interest in taking future courses through the digital platform, this highlights both the benefits realized of the content and the option of 'virtual' training through use of a digital resource training tool.

The use of digital systems and learner-centred and directed training resources is becoming a necessity for most all sectors. Being able to incorporate substantive content and learning processes using technology-based mediums to meet worker and, by extension, employer demands for skills and competencies will be a foundation of future learning, and participants affirmed through this question – and others - that the proper pillars are in place.

Should the System offer More, or Less, Interaction for Learners (Chart 22)

Digital learning resources are most effective when they employ a variety of tools and resources that pay attention to learner-enabled and learner-centered concepts. Aspects and elements such as use of diagrams, figures, videos, and illustrations on one end to the organizing of abstracts and resources and a focus on learning techniques and styles at the other end.

Ideally, questions and activities within the resource should attract attention and increase understanding, while also encouraging reflection, critical thinking, problem solving and even research.

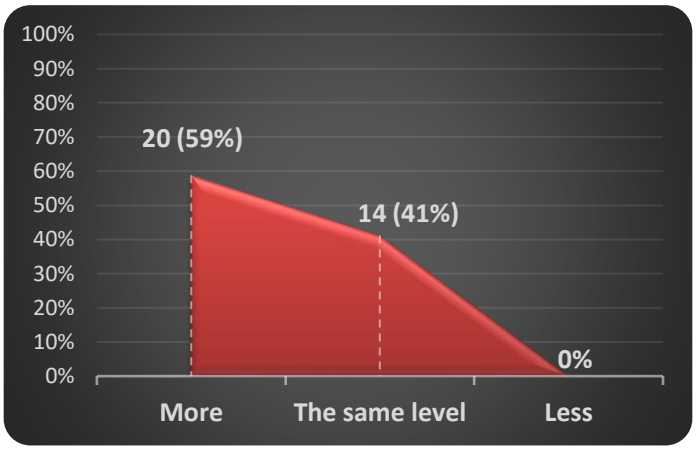


Chart 22 - Changes to System Interaction

And importantly, the content of digital learning resources must be in line with the objectives and target audience so that interactions are relevant and appropriate for the skills and competencies users need to gain.

Participant responses to the range of interactivity that was designed for the resources was very positive overall. A decent number of users, 59%, felt that there could be more interactivity while the remaining 41% felt it was good as presented. Non felt there should be less interaction. Developers should

continue to assess the key points throughout the learning resources where robust engagement is important and review methods and approaches used, but also secure input on a micro level to increase or enhance the tools and techniques for users to apply, based on sound learning and teaching principles for adult learners and best practices for digital resources.

Satisfaction with Length of Time to Complete All Lessons (Chart 23)

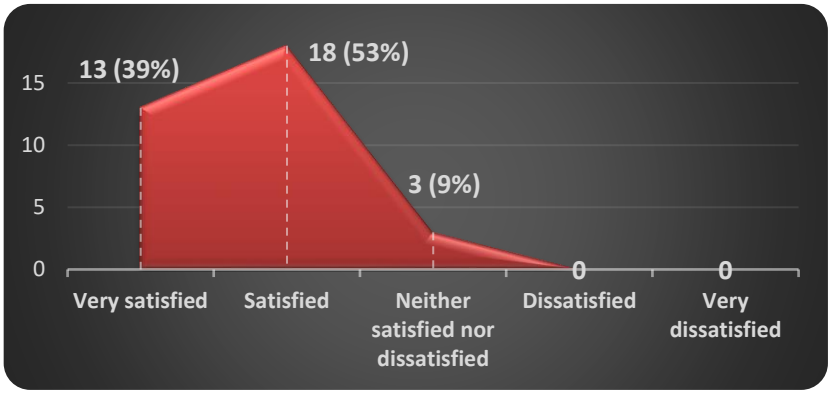


Chart 23 - Length of Time for Completion

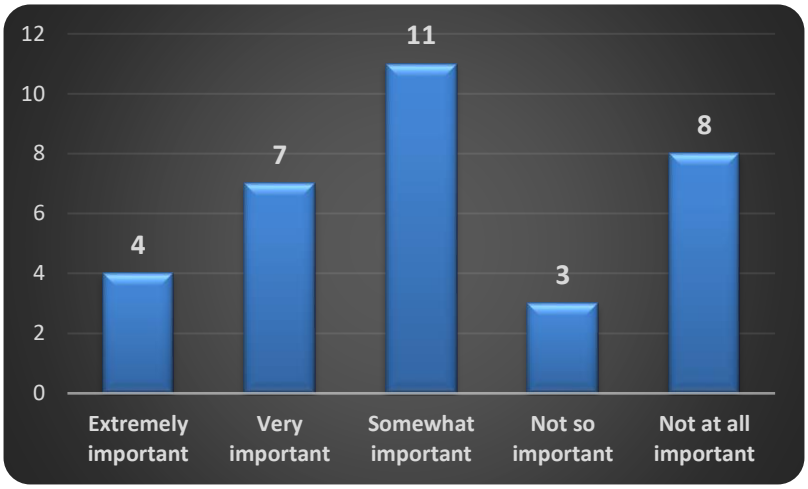
Participants were asked to provide input on the quantity of time in completing the individual Units and the entire array of lessons for the full digital learning resource. Considering that some participants completed all lessons in a home environment, some at work and some a combination of the two, overall there was positive feedback that the total time commitment was acceptable.

A total of 39% stated Very Satisfied and a further 53% were Satisfied. No participants were on the negative side of responses for his element.

How Important was Engaging with a Supervisor/Job Coach When Taking the Training (Chart 24)

In preliminary consultations and work with industry partners and key stakeholders from the sector, a key foundation that was established in respect of industry training was the important elements required for workplace training and workforce development.

Through development of a *Multi-Skill Program Mentor Guide*, one of the key principles for workplace training was the provision of some form of 'mentor' initiative that would offer the requisite guiding and instruction to learners.



Extremely important	12%
Very important	21%
Somewhat important	34%
Not so important	9%
Not at all important	24%

Chart 24 - Importance of Supervisor/Instructor

A mentor is an “experienced person within the industry who has achieved technical qualification” and whose role focuses on leadership and “providing workplace or site context for both performance and core tasks”.

The project initially intended to use and evaluate a mentor-based method for the overall training, but due to time constraints and lack of available personnel within the industry, a pivot was required away from this option. Still, a number of employers did provide some work-based or learner support from an experienced staff member. The participant responses reflect some of the dichotomy introduced in the project in terms of the value of engaging with a supervisor or job coach (i.e. mentor). Given that such a model was not formally introduced and utilized by all parties involved, participants were not provided with the type and level of guidance and support envisioned and, in the long run, important to success. This was reflected in the ratings where 33% of participants felt a mentor position was not important. While the same 33% response was in the ‘important’ categories, the majority fell mainly in the middle and noted that they were ‘somewhat’ important.

This leads one to infer that less positive ratings were impacted by one of 2 main factors:

- Given that most participants did not engage with a ‘formal’ work mentor for this project, they did not receive the potential benefits. Ratings then are based on speculation as to potential benefits had it been available.
- For those that did have a mentor-type influence, the experience was potentially one of high importance. As noted in other areas of the report, the mentor element was not as fully developed, implemented or tracked as anticipated, making it difficult to discern the true value and impact. Given the stakeholder goal of supporting workplace learning in the future through a mentor-type program, this topic should represent a priority for review, development and eventual evaluation at some level to ascertain best practices and formalize a model.

SECTION 6 Additional Research & Evaluation

Evaluation Questions, Data Sources and Indicators

Consultants should articulate any evaluation questions that have been developed at various points in the project, and any changes that have been made to those questions over time. If possible, please structure the evaluation questions against the following categories:

The primary evaluation method for the project was implementation of a comprehensive, online evaluation survey that targeted all participants who had directly tested the digital training system and content. This survey (see full survey in Appendix) included 40 unique questions that focused on all elements including the training content, subject matter, overall digital learning system, competencies gained, learning outcomes and the ability of the participant to apply skills gained to assist their employment or career advancement.

Implementation

(Process) What did we learn about how the program is being implemented?

Future development and implementations must ensure the training is developed with its focus clearly on upskilling and not primarily for any of the core training needed to qualify to write one of the 3 occupational licensing exams offered by Transport Canada. The benefit of focused upskilling for all aviation and aerospace stakeholders would reduce the risk of prioritizing technical training solely for a key but comparatively small group of technicians in an industry comprised of dozens of high-skill technical occupations.

Causal Attribution

To what extent will we learn about the extent to which any outcomes can be causally attributed to the project intervention? What information (qualitative or quantitative) would improve our confidence in the role the project played in achieving outcomes?

Numerous survey questions provide input/data for this question, but the completion of the training, and contribution to the survey itself demonstrates that both employees and employers are interested.

Additional Evaluation Results

The core survey used for evaluation of the digital learning resource was able to capture the core qualitative elements of the system from the perspective of the participants and, secondarily, some instructors. Additionally, the survey was structured to provide open-ended questions and opportunities for participants to comment on key areas and elements of the resource as well as for the full system in general. The primary analysis is included throughout this report, and the following table captures the key feedback submitted via the open ended methodology. We have presented in accordance with the evaluation framework presented earlier that focuses on the 3 main digital learning resource aspects.

Research Context	Strength/Weakness Response
Technical Quality	i. Switch all the presentations to the more natural sounding AI readers. ii. ai/text to speech voice was a little hard to understand/distracting at

	times; required rereading and understanding the topic…but overall was minor. iii. To improve the course make it more user interactive. iv. Having used a logbook in the past a Digital one is great. v. It is hard to be specific while also making sure that the students know to refer to the AMM but even simple things like how to read a caliper or micrometer were omitted. vi. The voice of the speaker could be changed, sounded too digital
Learning/Teaching Quality	i. Some areas not really detailed, I felt only a basic and quick explanation of the aircraft systems. ii. The experience was very helpful. It gives detailed facts in every topic area. iii. The content provided was commendable regarding its structure, range of topics, and overall presentation. iv. It might be beneficial to delve deeper into the subjects rather than providing a mere overview. v. Introducing more challenging quizzes could encourage a more detailed engagement with the material presented. vi. Improve consistency between content and quiz. Some units had wrongly formulated questions. vii. When you introduce the lesson first, do it with fundamentals just to give people an idea then they'll be encouraged and motivated to pursue the full course. viii. Add more aviation system topics. ix. I think more questions are necessary to facilitate a better understanding of the course. x. It was interesting but not all the information was relatable. I was surprised how much I did relate to it though. xi. More interaction in the theory presentations would be nice. xii. Employ real life pictures, specifically of common faults, fatigues or errors. xiii. Some presentations have too much text, some images can be presented with real examples, some real person experience videos could be added. xiv. I thought the interactive parts and the exploding diagrams were really helpful and kept me engaged.
Academic Quality	i. This might be a good training course for someone new to aviation who hasn't been exposed to the maintenance side of things yet. ii. It might be beneficial to delve deeper into the subjects rather than providing a mere overview. iii. It was easier to take a course like this compared to a course with a teacher in the front of a classroom; I highly recommend it A+. iv. Using standard practices as a starting point would be more helpful than a lot of the content of this course. v. I believe there is room for improvement in terms of course structure and content delivery. I encourage a thorough review and potential revision of the system to ensure a more organized and engaging learning experience. vi. The course was great and a great learning experience. vii. It helped as a refresher of different topics I learnt in college.

Table 4 - Additional Participant Input

Discussion on Additional Implications

We welcome any discussion of potential larger lessons to be drawn from this evaluation, with appropriate caveats clearly articulated. FSC is interested in highlighting potential broader implications along the following dimensions (while recognizing that not all evaluations will be equally available to address the questions articulated):

Dimensions	Key Questions
Expansion	Is there a need to expand the program or project to reach new population groups or different geographies? Why or why not? The research and evaluations clearly reinforced that the core elements of the digital learning system and micro credential levels offer a desired and effective option for workers and employers involved in aviation inspection. There are 3 main areas of expansion that should be considered and implemented to assist the main stakeholders: 1. With above development, expansion should focus on a national level promotion to be able to target companies and workers across Canada. Particularly, given that this new system offers significant accessibility and, likely, lower training costs for companies vs. engagement in classroom and education institutional training, the ability for small to medium enterprises will be highly impactful in light of tighter and limited training funds that often exist for their workforce. 2. This project, and the key elements that introduce new workforce development options and opportunities, offers some leading-edge options that can provide beneficial for a broad spectrum of occupational categories for the sector. Digital training, industry developed and recognized standards, self-directed and 'in flow of work' resources and content, and micro certification system and levels are some of the pioneering options that this project has established. There are a significant number of aviation and aerospace occupational categories that such critical elements can be highly beneficial to and that don't currently exist. Expansion over time into new occupation groups and the associated skills, competencies and certification requirements within the industry would serve to address several of the key challenges, gaps and negative impacts being experienced in training, recognizing and retaining the workforce.
Adoption	Are opportunities for other organizations serving the populations in question to adopt elements of what was being explored here? Why or why not? What factors are critical here and in what context? There are 5 main areas of adoption to be reviewed by those engaged in industry and workforce training. 1. Employers and workers integrating the digital learning resource into their existing training protocols and systems for relevant employees. Once all 3 levels of the digital learning resource are fully tested, industry wide education and promotion can begin to engage workers. There are multiple steps involved to administer elements such as the digital logbook and workplace mentoring or training systems. However, the party responsible for implementing these elements is the employer. A comprehensive guide should be created to educate stakeholders using the system and to give directions on how to establish a mentor-type program. Adding reports for stakeholders would provide detailed feedback as learners progress through training and would support a quality improvement process. The formation of an Aviation Inspection Panel to review, revise, prioritize and plan would provide consistent oversight of the

	system itself and the content of the digital learning resource. 2. Transition elements of digital/micro training systems driven by industry to other occupations. The longer-term strategic direction for the industry is to establish a Multi-Skill Program framework at a national level and ensure it is accessible to workers and employers and that covers a range of occupations. The basic framework is industry developed training through digital learning resources in the workplace. Transition from current training systems and resources will require advocacy to coordinate the numerous elements and parties (internal and external) required. Industry must advocate for implementing a new model which involves linking regulators, technology, sources of funding, occupational standards, learning & teaching expertise – to name a few. 3. The integration by external education and professional development. The industry will always rely on and must interact with external bodies that provide the sources of qualified workers for various positions found across the sector. This may be at post-secondary level with colleges or universities where specific degrees or diplomas are required, with private training institutions that often focus on specific occupational training or certification, or at secondary levels with internships, cooperative education or hybrid apprenticeship and basic skills certification options. It even extends to regulatory and government bodies that establish the credentialing or licensing requirements and, often, the delivery bodies that are approved to provide training and certification to the sector. Some of the challenges and weaknesses that have been identified by industry over the years regarding workforce training relate to the capacity of external trainers to train enough qualified workers across numerous occupational groups. Many factors at play have been written about extensively, and relate to issues such as cost, timeliness, accessibility, applicability of materials or equipment, classroom, and instructor lead vs on-the-job. Moreover, the key element missing from all third-party programs is 'workplace' and 'in flow of work' training and learning. Employers want to deliver worker training specific to their existing conditions and which covers the requirements of the job as well as duties within their own business environment. To achieve this, industry must engage fully with educators and trainers to establish new mechanisms that integrate, utilize, and deliver the core skills and competencies required for unique occupations where they, in fact, play a role. 4. Engagement & Adoption by TC on certification and standards – logbook. One specific element of the project was the implementation of a digital logbook system. This tool linked to the key skill/competency areas and provided a mechanism for workers to document their performance of tasks. A qualified evaluator – internal or from industry – evaluates and signs off on each demonstrated skill. Employers and workers noted some issues about this new logbook system through the evaluation and which the industry should further research and address for future development and implementation. Some of the key items for review and eventual integration and adoption include: • Integration of any specific skill/competency level requirements of Transport Canada, (TC), to the industry digital learning resource to ensure equivalency and matching. • Eventual recognition by TC and industry that certification and signoffs within one 'system' will allow for automatic endorsement of the qualification to the other. 5. Industry Recognition. • The sector needs to endorse a full Multi-Skill Program and all the elements integrated into the digital learning resource. • Establish an Aviation Inspection Panel to oversee the ongoing quality assurance and development of the content, tools and systems used for the digital learning

	resource. • Establish and confirm the standards identified for all levels of training and recognition of individuals achieving the standard by employers. • Develop and support a 'mentor' system that can assist companies who don't have licenced or qualified instructors or AME level professionals. • Provision of licenced and qualified professionals available to the sector who are able to certify and sign-off on skill and competency areas for workers taking the training but within companies that don't have individuals with the required credentials.
Investment or Partnership (actual or potential)	Did the project in question attract additional investment or partnership support over the course of the FSC engagement? If so, what factors might have contributed)? The project did not receive direct financial contributions once it had commenced, but the employers and participants did commit time and resources towards the testing and evaluation elements. For all participants there was a commitment of time to test all training resources and the digital system which, on average, amounted to 15-20 hours of engagement time. For some employers, their commitment came in the areas of participant use of a work setting computer system, support from a supervisor/instructor to assist participants during the training period, support to review and engage with the participants for the administration of the digital logbook elements. A few participants were also engaged in a focus group session.
Lessons for service delivery	What larger lessons for service delivery did this project provide? The project advanced some entirely new models to the sector in occupational training for existing workers. The introduction of micro credential learning units and certification elements for skills and competencies through a new digital learning platform was shown to be a positive and supported opportunity for workers and, overall, the sector. Numerous advantages were identified through the project that offer the sector some new directions in terms of the delivery of training for the workforce. • Industry driven and coordinated training that has potential for ensuring current skills, resources and teaching materials meet changing requirements and give industry ability to make more immediate adjustments. • Utilizing virtual platforms and digital learning resources can reduce the costs for accessing training to many employers and workers, thereby reducing downtime, off site time, impacts on production, overall training costs. Removing the barrier of distance and accessibility to specific training is a significant opportunity for workers and employers. • Quantification of virtual learning having equal capability as in-class settings for many work-based skills that employees need to acquire, with an advantage of being available to employers and employees for use in any situation. • It is important that industry provides training for the core requirements of aviation inspection skills and competencies and that, where needed, employers can enhance for company-specific training. Establishing foundation skills for the occupation is the primary role for the digital learning system while custom requirements are incorporated in the flow of work using a company's own systems or equipment. • The benefits of workplace learning and in flow of work training are significant for this occupation. This type of training delivery, however, requires the ability and commitment of employers and workers to establish the mechanisms to use the

	digital learning resource in a work setting, in conjunction with the proper supports, instruction and mentoring that forms the basis of all effective learning programs.
Lessons for policy	What larger lessons for policies at various levels of government should be discussed? The ethics application process was excessive for the relative risk in this project.

Table 5 - Additional Discussion

Appendices

A. Project Marketing Flyer
B. Participant & Employer Project Guide
C. Evaluation Survey
D. Content Summary for Level 2 Aviation Inspection Used in Project
E. Rubric for Project Learning/Resources
F. Registration & Consent Form
G. Common Outcomes Framework