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Accelerating Familiarisation Using Virtual Reality and Self-Directed Learning

Introduction

Familiarisation is a process in organisations that is frequently used to come to understand the nature and context of a process or a thing. A person will gain familiarity not only with workflow, processes and tasks in a traditional sense but now includes familiarity with systems, digital tools and concepts in addition to their traditional job. The need for familiarisation has increased but the resources to support it have not.

SHIPBUILDING TRENDS IN AUSTRALIA

The Naval Shipbuilding Strategy has highlighted the potential for growth in shipbuilding industries across Australia in terms of already known new builds, sustainment activity and newer builds coming on line. With this comes an opportunity to establish an advanced manufacturing and export capability suited to the 21st century.

New approaches, tools and processes are all a part of this and building on Industry 4.0 changes that are strong in Europe comes the concept of Shipyard 4.0 foreshadowing the digitalisation of the industry and other advanced manufacturing that Australia will tackle. This will entail riding a wave of change that is sweeping shipbuilding worldwide with changes such as:

- Distributed design where the design function can be done entirely separate from the production, even in another State,
- Modularity where blocks of a new ship can be built by highly efficient specialists in factories, not necessarily in the shipyard,
- Industry 4.0 combining additive manufacturing, automation and data sharing in logistics networks,

- Lifecycle Planning where consideration of the evolution of a ship is built in from the concept design on,
- Digital twin where the initial CAD model evolves with the ship and is used throughout every stage of it's life, and
- Vessel specific systems that allow for unique capabilities across a fleet.

In addition to new ships being built and sustained across multiple locations across Australia, other influences will shape the nature of Australian Shipbuilding over time. Naval technologies will change faster than the shipbuilding process and so upgrades will be constant which could also mean structural changes such as the new towers on the Anzac frigates to accommodate upgraded electronic systems.

There will be regulation changes too which will reflect the changes in Defence, Government and Society around environmental concerns, energy efficiency, security including cyber security and safety and public liability. This changing landscape of requirements will have continuing impact on the operation and even the design of ships.

During this time the shipyards will adapt and refine their processes and workflows to build an export capability that can be maintained after the current crop of ships. This will only be possible if a workforce with appropriate skills and talent are available to not only do the work of the day but re-skill for tomorrow. This in the face of resource industry booms and other sector demands such as manufacturing and construction.

Thus the role of learning will be crucial in achieving the goals of the National Shipbuilding Strategy, improving productivity, reducing re-work and lowering costs. In amongst this learning mix is the process of familiarisation, often performed in a physical setting and delivered face-to-face in groups by experienced staff.

DIGITALISATION

The key new driver for the bulk of the changes to the Shipbuilding industry, in line with big changes in many other industries, is digitalisation. This is already underway in some aspects of the workflow of a ship build, predominantly beginning in the design office. There is much to come and fast if the examples of Australia's overseas partners are to be a guide. Other industries such as automobile manufacturing and aerospace are considered to be years ahead.

The new tools can be adapted from other industries and with them, the possibility of importing the skills and talent to use them but this is not always possible and competition for these new skills is becoming fierce.

The emergence of product lifecycle management (PLM) technologies that are tailored to the unique challenges of developing advanced ships has been partially responsible for Integrated Product Development Environments which allows for parallel production across different and diverse teams. This results in productivity gains, improved shipbuilding performance and ultimately gains in the total cost of ownership of a ship.

The PLM combines tools for product modelling using 3D computer-aided design (CAD), project management and coordination tools, 'database' features to manage parts, suppliers, and production information in a completely integrated way. This approach scales across multiple teams and multiple shipyards.

Another idea across this new, integrated shipbuilding landscape is that of a digital twin or virtual twin. The concept here is that the digital model developed as part of concept design, carries through to detailed design and engineering, production and ultimately to the operation of the vessel. The design is developed as a 3D model, same with the engineering phase although not always in the same systems. Bringing the actual build data into a digital model is challenging but possible. Then the operational data and live data from sensors etc can become part of this evolving digital twin model.

Sensor data for the operational ship is gathered from large numbers of sensors and analysed for anomalies which can be used to tune performance or predict possible failures. Currently this data is largely brought together in the form of data lakes but increasingly this data is analysed at the edges using machine learning on the sensors themselves.

A more recent addition to the suit of digital tools in shipbuilding is that of virtual reality. The digital models at concept or detailed design stage can finally be experienced by the non-expert as if they were real - allowing inspection, review and problem solving as if the ship were already built. Parts of the same model can provide the detail of compartments or blocks for production. The addition of collaboration tools inside of VR now allows for multiple people to undertake these reviews which can occur across the world involving experts for issue resolution, annotation of models for change by designers and recording of joint decisions for contract variation.

TALENT, SKILLS AND LEARNING

There is a need for talent and skills but not only to bring onboard new skilled staff but to up-skill existing staff in a continuous manner. This aspect of Australia's shipbuilding capability and skill needs was noted in a report by the Rand Corporation [1] and was also published in the more recent Naval Shipbuilding Plan [2].

There are initiatives underway to address this skills gap, pre-eminent among these is the National Shipbuilding College working with existing providers such as TAFE and Universities initially. The nature of continuous change in the industry challenges the premise of existing providers whose current operations largely focus on long-cycle, certified training.

There is certainly an important role for certified training just as there is for other types of learning in the enterprise and across the shipbuilding industry. The new digital tools promote learning in many ways as a natural consequence of their capacity for integration, coordination, collaboration and knowledge sharing. These are capabilities common to the needs of a future shipbuilding industry and a learning environment.

Given the nature of the future changes to the industry and the speed with which these changes will have to come, an examination of non-certified learning should occur to both speed up the adaptation to change and provide a means through which the skill portfolios of individual workers can better reflect their actual talents rather than their job descriptions.

There is an option to explore newer, emerging learning modes that can be supported by digital technology. One of these is the need to contextualise the application of work skills and knowledge in the industry. For example, a contractor arrives to perform a work package on a ship refit. They have the right qualifications and have worked on other ships but the unique nature of the ships described earlier and the unique situation of any one task makes it difficult to quickly come 'up to speed' to do the task at hand. In this case the contractor is given a familiarisation with the specific context in that yard, on that ship, in the compartment he will be working on.

FAMILIARISATION

Familiarisation often currently takes the form of job shadowing where someone new to the job or area of the workplace is asked to follow a more experienced worker around [3]. Trickle-down-familiarisation (eg one crew member training another) is not no longer acceptable in terms of the speed of uptake. It is unstructured, leads to incomplete knowledge of the equipment capabilities, especially the lesser used functions [4]. Alternately, this can also done in groups with a leader which compounds the issues with the way an individual can learn what is needed to successfully do the job since this familiarisation is group based and inherently lowest common denominator for expediency.

Familiarisation is a form of learning in an organisational setting, be it a Shipyard, a design office or a clerical area. It is not standardised, is very difficult to assess, cannot be measured as to quality and therefore cannot be part of a program of continuous improvement [3]. Yet, it is occurring to differing levels of success and with little consideration of the learning nature of the task in that there is little evidence of the conscious application of learning theory to the various familiarisation efforts.

Taking the drivers for familiarisation and the constraints that work against it such as the resources needed for one-to-one familiarisation, the need to transport contractors to a site to become familiarised and the increasing complexity and speed of change in the workplace - a new, more considered approach to familiarisation is needed. Familiarisation is becoming more frequent, more complex and in many ways, more urgent in modern shipbuilding industry.

Any new approach should also take advantage of the digitalisation of the shipbuilding industry to extend the availability and access to familiarisation and improve the richness of it in the context of the job itself. In this way it could be possible to accelerate the process of familiarisation and also increase the number of workers who could participate because it would lessen the need for existing workers to be involved.

While Familiarisation isn't the same as Certified training, it is sometimes called Familiarisation Training which can cause confusion and it is useful to differentiate the two and also to place other forms of organisational learning into this context because the terms can be used interchangeably by some whereas there are clear differences.

In work done by Stirling Labs, this point became clear and a workshop was undertaken to differentiate these types of learning with a client organisation who was seeking to establish an approach to Familiarisation that would fit into their business context and avoid

Organisational Learning

Certified Training	Induction	Orientation	Familiarisation	Drill
Theory and concepts	Less formal	More formal	More frequent	People
Application	Organisation focus	Job focus	Workspace focus	Simulation
Generic	Welcome	Expectations	Location, tools	Communication
			Meaning in context	
			Ownership	

the confusion. These differences can be summarised by the following:

LEARNING MODELS

If we consider how familiarisation occurs currently, it appears that there has been very little thought given to the process other than it being the transfer of information from one to many or optimally, one to one. If we think of familiarisation as a form of learning though, there are some considerations that would make the process more effective and also take advantage of the use of digital technology.

Firstly, the participants are essentially adults who have already undertaken at least 10 years of school and formal learning, are able to think in terms of concepts and in the context of their job, are motivated to learn. This differentiates familiarisation from the sort of learning that occurs in school which is called pedagogy or child learning. Adult learning is called andragogy, a term used by Malcolm Shepherd Knowles and he defined it as the art and science of adult learning. It now refers to any form of adult learning [5].

Knowles defined 5 assumptions about adult learning that are different from those that apply to child learners, they are:

- Self-Concept - As a person matures his/her self concept moves from one of being a dependent personality toward one of being a self-directed human being.
- Adult Learner Experience - As a person matures he/she accumulates a growing reservoir of experience that becomes an increasing resource for learning.
- Readiness to Learn - As a person matures his/her readiness to learn becomes oriented increasingly to the developmental tasks of his/her social roles.
- Orientation to Learning - As a person matures his/her time perspective changes from one of postponed application of knowledge to immediacy of application. As a

result his/her orientation toward learning shifts from one of subject centredness to one of problem centredness.

- Motivation to Learn - As a person matures the motivation to learn is internal [6].

Knowles went on to develop ideas around another characteristic of adult learners and that is that they are self directed in that learners are motivated to assume personal responsibility and collaborative control of the cognitive (self monitoring) and contextual (self management) processes in contracting and confirming meaningful and worthwhile learning outcomes [7].

FAMILIARISATION+VR+COLLABORATION

Virtual Reality has long been on the periphery of technology (since the 1950's) for a variety of reasons but recently the decreasing cost of the computing power, increasing capability of headsets and quality of software have combined to make the VR experience (VRE) affordable and useable. A key factor are the head-mounted displays (HMD) which is worn on the face and all head movement is captured, when used with appropriate software, the user's perspective of the VRE will always be correct regardless of where virtual objects are or where the user is looking. This is in contrast to other technologies that are sometimes referred to as VR, such as "caves" or 3-degree-of-freedom, video based HMDs. [8]

The VR hardware provides a computer-generated visual experience and the software can use this capability to present a VRE that creates what Slater, M. [9] calls the place illusion (PI) and plausibility illusion (PsI). Essentially the VRE causes the sensation of being in a real place (PI) and that the scenarios witnessed, such as colleagues conversing, is actually occurring in this place (PsI).

A central advantage of using VR for visualisation is the elimination of abstraction such as translating a 2D plan or a flat screen 3D representation or projection. This means that the immediacy of the model being viewed is instantly natural because that is how we see the world and have done since birth.

From a learning standpoint, there are even more benefits that can be derived from VR. Research now suggests that immediacy and 'realness' of VR make it suited to support two powerful dimensions of learning:

- Experiential Learning - experiential learning engages most of the senses, builds social-emotional skills, creates a context for memorisation, expands critical thinking and is unquestionably more relevant to real life applications of what's being studied. [10]
- Personalised learning - a diverse variety of programs, learning experiences, instructional approaches, and strategies that address the distinct learning preferences, interests, aspirations, weaknesses, or cultural backgrounds of individual students. The result of this is an educational experience that's more fitting to you as an individual and maximizes what you can get out of each interaction. [10]

This also allows for the an individual learner to engage and re-engage with the model and annotations which will take advantage of the self-directed nature of the familiarisation model. This means the combined impact of experiencing a ship as if it were real, doing this as many times as you need to learn (become familiarised). It allows for the an individual learner to engage and re-engage with the model and annotations which will take advantage of the self-directed nature of the familiarisation model.

If we can then add the capability to collaborate in VR, then we not only allow interpersonal dynamics to be part of the experience but we open up the possibility for interaction with experts, mentors or other learners inside the space. These interactions are not limited to the physical availability of others since these interactions can occur from anywhere in the world via the internet.

This additional capability of new VR environments supports a third type of learning relevant to our familiarisation model

- Mastery Learning - where a learner moves forward when you truly master a subject, without feeling humiliated for taking your time. The end result is actual knowledge that can spread interconnect with other subjects in a number of unexpected ways, both creatively and intellectually. [10]

The need for familiarisation in organisations is currently recognised and resources are being allocated to it but this paper is suggesting a new approach based on treating familiarisation as an adult learning activity that can take advantage of new technologies such as VR. The costs associated with the more traditional approach of physical familiarisation in groups means that is not done as regularly as needed or effectively as possible for any one individual.

The benefits of treating familiarisation as a form of adult learning that promotes self-directed learning appear appropriate and can be tested. The use of VR offers many advantages including familiarisation learning on ships that are still in the design or construction stage. Add to this the capacity for learners to solve problems together using collaboration tools and it becomes an approach that offers a powerful logic for exploration.

More obvious amongst the benefits are:

- Effective use of resources and time because the individual drives the learning and accesses help when needed for clarification or additional learning,
- Use of VR for experiential, personalised and mastery learning for familiarisation supports the nature of self-directed adult learning,
- Collaborative problem solving as a context for familiarisation,
- Communities of practice can be built on the back of these activities to continue learning and
- Knowledge sharing becomes possible across the distributed digital shipyard.

Stirling labs will be undertaking a number of projects in the next year with clients who are already interested in exploring this approach to familiarisation and through that time, the models will be tested and refined.

References

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