# Handicrafts and Technological Integration in the Omani Context: Challenges and Potentials

## Dr.Hamda Al-Shihi
Department of Information Technology,
Colleges of Applied Sciences-Sohar,
Ministry of Higher Education.

## Dr. Qasim Al-Mamari
Department of Information Technology,
Colleges of Applied Sciences-Sohar,
Ministry of Higher Education.

## Dr.Ali Al-Musawi
Department of Instructional and
Learning Technologies,
Sultan Qaboos University, Muscat.

**Abstract**.

The political and historical stance of handicraft marks one of the most resistant cultures for technological implementation in the current postindustrial world. This paper explores ways of leveraging the relationship between the Omani traditional handicraft industry and technological innovations, and the main boundaries for technological implementation in handicraft training.

**Keywords**: Handicraft, Craft Industry, Craft-Technology Integration, Oman.

# 1 Introduction

The craftspeople argue that the technology plays a subordinate role and that human being is the source of creativity. As technology could actually disconnect them from reality, they perceive a hybrid practice combining the technology and crafts practice better and call for advancements of haptic interfaces that exploit on the neuromuscular connection between hand and brain [28][1].

The use of information and communication technology (ICT) to build human resources is a vital prerequisite for the development of knowledge-based economy especially for developing countries. While the adoption of E-learning systems has been growing in training fields, the integration of ICT tools in the development of handicrafts training has attracted little attention not only in Oman but also worldwide. This can be attributed to factors such as the expensive equipment and modelling software, and the disapproval from traditional craftspeople.

Currently a number of technological advancements are used in the process of craft making and marketing worldwide. For example, 3D modelling software such as CAD and CAM are used in the design process, rapid prototyping technology such as 3D printing and scanning are also used, Web-based services and social media applications are used in international marketing. Computer-driven machines such as CNC are commonly used to support fabrication and production.

---

[1] - TACITUS research Project (http://www.eca.ac.uk/tacitus/papers.htm)

Nevertheless, even this low-level of technological use in craft context is still debatable as the literature review and the Omani principals of the Public Authority of Craft Industry (PACI) reveal. This, on the one hand, is due to the political and historical stance of crafts as being perceived resistant to technological implementation, and, on the other hand, is because the embodied process of making craft is, in itself, considered a national heritage. This process is distinguished by developing tacit knowledge or practical knowledge of "know-how" which is difficult to codify thus intensifying the saying that "different kinds of making provide different kinds of understanding" [8]. The use of technology threatens the authenticity of craft practice, its national value and cultural meaning. However, as the technology has unarguably become an essential part of learners' culture/learning in and outside educational institutions, craft training/making should make use of technological innovations in order to sustain crafts within new technology-based generations. In traditional handicraft world, research is required to focus on this area where it invests on embedding technological innovations to support craftsmanship continuity. This study presents a literature review of handicrafts definitions, educational models, challenges and potentialities for technological implementation in craft education. Then it discusses these within the Omani context and highlights the main motivations underpinning handicraft industry development in the Sultanate of Oman based on meeting with the Public Authority of Craft Industry (PACI). The discussions reveal that the "traditional modes" of training is a valued tradition in the Omani context. Technological integration is welcomed but within the limits of preserving "traditional knowledge" and protecting "craft trade secret".

## 2 Literature Review

### 2.1 Craft and the Limit

This section reviews crafts definitions and its status in order to identify its constituents and the role both education and technology could play in leveraging craft industry within the current industry-driven world. This section informs the discussions of the boundaries and initiatives taken by the responsible bodies of handicraft sector in Oman and provides a rationale for their perspectives of technological implementations in the Omani craft-making context.

Craft Definition and Constituents. Crafts position in contemporary culture is observing a convulsion due to industrial, post- and trans-industrial dominance invading all aspects of lifeworld. Historically and politically, in the western world, craftsmanship gained embodied and productive reality as an opposing force to industrial revolution characterized by machine production. The embodied reality of craft formed a cultural differential symbolism where it represents both culture and history. At the same time, it becomes a measure for the quality and value of the object produced at the end of the process of making. This embodied reality where the direct "manual contribution" of the artisan is considered the "substantial component of the finished product" [29] stands as a solid shell resisting industrial modes of production.

[12] has shed some light on the "disjuncture between 'craft' etymology and the constituency it is expected to represent". [12]'s analysis shows that although crafts stood for the "making of things" where "the making process was at the heart of craft aesthetics and politics", the term kept developing and changing without gaining a "consistent meaning". In the nineteenth century, the term developed an internal dynamism for being a constituency of three elements that were distinct before and which split in the twentieth century due to external influence such as the Cartesian duality and the demand for functionality in crafts. The *first* one is decorative art which was reduced genres such as painting and sculpture and were disenfranchised. The *second* is vernacular referring to "the cultural produce of a community, the things collectively made, spoken and performed" [12]. Vernacular is identified with the pre-industry age where, given modernization, its characters as being "rural & handmade" and its status as being "authentic" culture motivate its persistent presence due to the desire to either "return to the vernacular world" [12], nostalgic invention or preservation of tradition.

The *third* constituent of craft is the politics of work which provided crafts with its "moral core" [12] as creative works become an important force for the resistance of the machinery dominating industrial revolution and political control of work place. "In this sense, craft - creative work - was about the empowering of individual workers, about the political control of the work situation. The objects produced were a by-product of this larger ideal" [12]. The fractionalization of craft in the twentieth century staged crafts as a

pure technical activity where craftsmanship becomes to be identified with the non-intellectual mechanical practices or manual skills [12].

**The Limits of Craft**. In his art/craft debate, [1] asserts that art potential is driven by the impulse to "transcendence of all limits", whereas "craft involves self-imposed limits" (2007, p. 4)[2]. These limits are the borders determining craft inferiority to art and asserting the former marginalized status. Instead of responding to the impulse of 'delimiting', 'freeing' or 'opening' craft, [1] defines the limits as an amalgam of five "interrelated core principles" [1] which he discusses along theoretical or historical lines, and demonstrates through illustrations of artist/crafters practice. Taking craft as a process, "an approach, an attitude or a habit of action" that "only exist in motion" and as "a way of doing things" [1] as well as a cultural practice, [1] then elaborates craft as supplemental, grounded on material, qualified through learned skills, pastoral and amateur.

First, the placement of craft as supplemental where it is taken "simply as a means of getting to a finished form well" [1] yields the craftsmanship process a power similar to the object produced and thus making them inseparable. Craft as a process of making qualitative considerations to achieve its objective disappears once the object makes its autonomous emergence. Yet the falseness of the object's autonomous totality that separates it from the process - as if the object is being a complete whole- is observed only when a lack or a problem is realized in the object[3]. *Second*, craft involves material experience and direct engagement with material properties [1]. The material "will always remain partially resistant" [1].

The "encounter between the body and a particular material" which he terms "facture" enables propping the material and discovering its limits and possibilities, thus allowing further creative potentialities. This is reflected in the *third* principle, which is craft skill. Craft skill is acquired through the learning process which is based on the direct engagement with the medium, and the experience of this engagement as crafting. This process of long-term, medium-based and localized practicing accumulates as a timeless "an ineffable, special quality" of the practitioner. The fourth principle is pastoral which means that craft

---

[2] - This paper is not interested in the debate but on the presented craft analysis.
[3] - [1] refers to a circle with deficient shape

indulges a feeling of historic and rural aura that is brought to fit in the real and complex world. In this sense, "pastoral craft has been part of a purposeful invention of an "authentic" past" [1]. The final principle is amateurism where amateur activity is defined as "a lack of critical distance from the object of desire" [1].

This places craft with hobby and leisure activities as non-professional and self-referential practice. Although amateur craft based on skillful practice could successfully follow professionalization and be valuable to economy, the contemporary pressures to draw boundaries between professional and non-professional practices have bracket craft within non-professionalism enforcing the persistence of its marginalized status in the contemporary culture. Yet, for [1], craft has functional purpose and thus commercial value where it could serve for mass production.

The previous section highlights the value of the "making process" itself in craft production. The quality of the experiential knowledge of the making enhances the performance and leads to the emergence of a "qualified and individualized object". This process assures its quality through characteristics such as skillfulness, use of hand, length of duration and the engagement with the object and material. In summary, craft develops a dynamism based on the complexity of differentiating it from contemporary art and design, its embodiment of cultural practice and history, as well as its political stand as resonate for the human worker.

## 2.3  Quality-Based Craft Educational Models

Technological implementations have always been considered a great threat on craft practice. As previously noted, craft's moral core is in empowering individual workers against the machinery domination. The use of technology is linked with affective dis-connectivity in craft practice and object devaluation by the social community.

[25] insists that the use of machines has caused the loss of affective modality. Affective modalities, according to [25], characterized the artisanal age for a number of reasons.

First, the human being used his body to integrate different tools to operate and harmonize the whole [25]. He was the source of energy that is exercising and building, and the source of information, which

refers to learned skills through education. The exercise regulated the aim and the information of the material.

Second, the relationship between him, the object and its materiality and nature was immediate and in a continuous processual contact [26]. Object transformation was a multi-factored process between different forces: human and non-human [26].

Third, the man's work was the ―sole expression of his technicality and ―his need to work is translation of this need of expression [25]. His expression signified his expertise and efficiency through knowing his job, his tools, and the necessary modifications in insuring ―the internal distribution and self-regulation of the job [25].

Consequently, in the current industrial mode, a role-change in man's position is observed [25]. The man has become the source of information only and the source of energy is left to nature [26]. This means that technology incorporation in craft practice could result in lack of attachment between the craft worker, the object and the value that object represents.

Indeed, the craftspeople and the social community seem to share this common position. Less duration taken in the making process means compression of thinking time [11]. The object produced seems to lack liveliness, spontaneity and modeller's contribution which is seen as "an act of interpretation" that shows the "character of the piece" [11]. In principle, when technology is used over the limit of "just enough" to get the work done, negative social perception is observed. The tech-made object is *devalued* [23].

The role of education, training and apprenticeship in investing on saving crafts practices, especially traditional crafts, from being lost forever, and on identifying the outlines for forming new models of practices that assures the quality of the process and product must be highlighted.

[13] insists that craft education is very relevant and necessary for future sustainability. Industrial models have actually failed, consequently, leading to instrumental or utilitarian type of education, disengagement from the environment and alienation of oneself[4]. Crafts education can teach value of quality and perseverance, self-

---

[4] -The author refers to industrialization as "the enlightenment project"

worthiness. Time spent or slowness is treasured in craft practice. [16] has already argued for "… putting value back into craft education and training" in order to balance the needs of the overall industry. Based on his practical experience and analysis, he argues that the current educational systems

"…have drawbacks due to the short, modular, assessment-led units delivered to achieve specific performance standards[5]. Besides, ignoring the sustainability of crafts, its history and heritage for future generations, this disenfranchises students from having "any say in their future" [16].

The outcome is non-proficient graduates whose qualifications do not express enough craft knowledge or skills. To put value back into craft education, its role in reconnecting students to the traditional craft training and, simultaneously, educating them about up-to-date and modern aspects of craft must be emphasized in the curriculum. Craft educational systems should work in consultancy with industry and educational people through clearly routed academic programs. In the pursuit of high standards, quality work and ideals, these programs should contain mixture of theoretically constructed lectures and discussions, training through observation and practicing with craft experts, and well time-served quality apprenticeships.

Qualified craft learners must have conservation, restoration and historic background as part of their training and apprenticeship [16]. The instructors must be highly skilled master craftspeople who transmit knowledge, confidence and bride of crafts not only verbally but also reveal them through "conduct and interrelationships" [16]. This will be reflected through generations of learners valuing dedicated craft study and practice. For [16], the crafts image could be made through rooting education on the authenticity of the past, pursuing quality in the present and sustaining practice for the future generations.

## 2.4 The Potentials of Technological Implementation in Craft Industry and Education

---

[5] -Lynch focuses here on building or constructing craft particularly in craft education in the UK NVQ (National Vocational Qualification) system; but his views may be generalized for other crafts.

**Technology is a Facilitating Tool**. Craftspeople with traditional craft practice experience insist that "tools of technology are not tools of creativity" [23] and that their work is defined by their artistic vision and not technology limitation [23]. While they enjoy the "hands-on-feel" experience and value their "artistic integrity", technology helps them to "envision and execute" their ideas [23]. They keep assuring readers that technology plays a subordinate role in the life of craft and thus it could be disassociated from it at any moment. They demonstrate that a hybrid practice combining the technology with craft skills reinforce the embodied relations rather than winding them up. Using technology in combination with traditional tools and processes could extend craft people practices and facilitate new ways of thinking and doing and so create original new works [18].

**Technology as a Solution for Change Management**. For craftspeople and artists, technology could be seen as a solution for complex problems that constraints their creative potentialities. The transition to incorporate technology in craft making requires long time of practice for both using and applying technologies [23]. For example, in some cases, such as digital fabrication, accessibility and time to technology might require skilled technicians to rework the data and operate the machines which arise authorship issues [10]. However, the technology plays roles in managing change and creating new direction for both work processes and careers of craft practitioners [23].

**Applications of Technology in the Crafting**. Some of the areas where technology could be used are as follows:
Production and manufacturing process. In the production process, digital technology is used to produce forms that cannot otherwise be produced by human hand alone [10]. The manufacturing process are identified as *subtractive* where the object is cut or subtracted from the original material using computer-control driven machines (CNC) and *additive* where the object- which is mostly characterized by physical complexity, is build up layer by layer using CAD/CAM software. Then the object is printed using 3D printer, so that it can be casted or reproduced from another material.

Design phase. CAD and CAM are seen to spare the craft learners from "frustrations and disappointments of real making" as they are more content with the virtual and can make many more virtual objects

than the real one [8]. According to [11] these design and modelling software provide the designers with control over the shape, speed and provide speed, ways of dealing with increased workload and quickness of response to customers [11]. As these could be used to produce numerous of shapes, they are perceived as a "liberation" for creativity for designers [11]. [10] also argues that sometimes for craftspeople, the time spent in 3D modelling, error rectification, hand-finishing and material selection is considered 'invisible', in other times it could actually be considered "a pioneering craft in its own right" that confirm that "craft practice has entered an unprecedented new era" [10].

Human-computer interaction. The lack of sensory stimuli in digital crafting reported by crafts practitioners who feel that the extensive use of technology could 'disconnect', 'separate' or make them 'lose their grip on reality' [24] could be overcome by the physical manipulation of materials and tactile stimulation. These have an important role in exciting and modifying imaginative thought. [28] insists that "the need for development of enhanced haptic interfaces that exploit the neuromuscular connection between hand and brain in order to harness the creative potential of hands and fingers." In this sense, craft profession could make great use of development and of haptic, tactile and multimodal interfaces that challenge the traditional concepts of interaction.

Web based technology. This dominates collaborative social work, services and marketing. These enable combinational innovations which according to [7] could be orchestrated by entrepreneurs using or developing platforms such as Apple's App store, ePay, Thread less and Heartland Robotics. These platforms leverage the use of technology in marketplace which allows flexible micromultinationalisation where small businesses with fixed cost employ numbers of people. The increased quantity of the people participating or using these technologies provides increased accessibility for knowledge share and exchange, and thus more opportunities for innovations. [7] stress that the process of innovation "relies heavily on the combining and recombining of previous innovations". Web based technology could also facilitates the services for handicraft tourism such as purchasing, recasting and shipping.

## 3 Craft Industry in the Omani Context

This section elaborates crafts industry, definitions, and educational perspectives and models in the Sultanate of Oman. The attention to the traditional crafts in Oman has taken new directions since the establishment of the Public Authority of Crafts Industry (PACI) in 2003 (Royal decree 24/2003). The authority, taking on the strategies of sustainable development, has worked to promote crafts' investment through training, crafts production and marketing. A determined sustainability is perceived in the recognition that the craftsman is the center for development and continuity of the crafts tradition and Omani heritage.

Basing craft education on the "traditional mode" of the "traditional craftsmanship" has led to the emerging realization that there is a need to "re-apply the influencing factors that existed with the development of craft" which besides the raw materials, these include "the social opinion about it" [20]. This 're-application' of that what "existed" in the past culture to the current one is questionable because the factors influencing crafts' values, making and use have changed through generations. Unfortunately, neither the past relationship to the raw material or the opinion about craft can be conserved. In this sense, the reapplication of the past factors cannot sustain the relationship to craft's learning. In other words, the practices of crafting could be transferred without necessarily being sustained.

Challenges in traditional craft learning could be identified due to the transfer of the crafts practices from being 'framed' as a family profession to the industrial phase. The learners attracted to craft learning are known to mostly be "one of the craftsman's or a neighbor's sons" and are derived by being "interested in learning" as well as having "aptitude for learning" [20]. This motivates them to continue learning handcrafting especially with the loss of "the utility function for the sake of which the crafts exists" [20].

## 3.1 Al-Ajyal College

'Al-Ajyal College for Sciences of Craft Industries and Traditional Professions' by His Majesty Sultan Qaboos, 27/1/2013, creates a new 'scopic' dimension, as its name implies, towards this transduction. Reasonably, its establishment within an industrial era is intended to construct new ways of cultural and social perceptions and emotions towards traditional crafts and craftsmen that will dominate the coming generations. The word "Al-Ajyal" is translated as 'the generations'.

The aim of the college is to provide different programs to qualify the new generations to elevate, improve and develop traditional crafts and their industry. The graduates will be supported through entrepreneurship programs that help them to start their small/medium business. The college will hold 14 specializations taught within its different branches, which will be distributed over the prefectures of the Sultanate. The craft-prefecture distribution will be based on the local craft known and practiced by the residents of each prefecture.

As its name and aim imply, the Omani "Al-Ajyal" (*Generations*) College - as well as the training centers- seeks not only to sustain the traditional craft practice but also the relationship between different Omani generations through craft. On the one hand, it is expected to reposition traditional craft learning as an academic program among other contemporary academic fields that are currently driving the passions of the new generation, and these are more likely to be technology-based such as computer science and information technology. On the other hand, being an existing option of study means it becomes a field of professional practice rather than of amateurism. The amateurism, interest and talent become subordinate factors of the study in a culture valuing qualification and industry as a means for getting employment and better life opportunities[6].

Currently, as it seems, handicraft is threatened to be a marginalized practice. However, as the context of this paper shows, the Sultanate of Oman has taken a different direction than the one stated by the literature review. The establishment of the PACI, the increased number of centers and eventually the announcement of Al-Ajyal college, all are reinforcing the professionalism of traditional craft as a scientific and cultural practice.

## 3.2  Technological Integration in Omani Traditional Craft Education

This section reports on the three meetings held between 2014 and 2016 to explore the potentials of the technological innovations and implementation in the traditional handicraft industry training centers

---

[6] -Of-course, the ideal option for students is usually to select what they are interested in, however, currently the students are recruited based on their need for qualification and jobs, and they are distributed based on their marks. Al-Agyal College will have to be considered within this system.

in Oman. The meetings took place in the PACI with leading principles, decision makers and directors of various centers and departments.

**The First Meeting**. This took place on September 2014. There was a general agreement on exploring the e-learning opportunities in the Omani handicrafts training centers. A tour to different departments was advised by PACI principals in order to get updated with the current concerns and projects of the PACI.

The tour resulted on collecting the necessary documentations and publications of PACI from the media center, and information about the training centers and training syllabus from the training department. It was found that the PACI has a major interest in obtaining intellectual property rights (IP) for Omani handicrafts and craftspeople. Another interest articulated by information technology department is E-marketing and establishing a network between the different training centers. The projects concerned with technological implementations in craft industry in Oman are limited to the transformation to e-government. This includes developing a database of crafts and crafts people as well as an electronic gate to enhance online services and communication [4]. Different social media accounts have been opened to publish the PACI activities and increase the audience national and international wise.

A visit to the Center of Graphic Design, Decoration and Documentation Production showed that 2D software programs such as Graphic Designer, Adobe Suite, Coral Draw are used for design. Some of the designers expressed the existence of a gap between the graphical design and the actual design. This was due to the designers' lack of knowledge of the crafting skills and the specific raw materials. The designers suggested that a workshop focusing on exploring raw materials used in handicrafts might help them in aligning their design perspectives with the material type and proprieties.

**The Second Meeting**. This was held on February 2016 and it focused on discussing the constraints, challenges and potentials of implementing technological innovations in traditional craft in PACI training centers. The discussions highlighted the following points:
*Challenges.* The PACI is cautious about the integration of technology in handicraft training context and the consequences of that on altering the process of craft practices acquisition. The fear of the ''automata''

overriding the traditional practice was articulated by PACI principals. Although mechanization or machines have been accepted to some extent in some crafts such as silver making where it is employed in raw material processing and preparation, but this acceptance is based on the terms that the machine is a tool that helps the craftsman focusing on craft making and the object per se.

Potentialities. Most of the potentials for technological integration in craft industry were related to the value of its economic impacts. Increasing production and opening entrepreneurship opportunities for small and medium companies (SMC) such as:
- Creating production line
- Capturing and preserving threaten practices especially of aged generations who have valuable knowledge that enhance the understanding and creativity in craft production.

Constraints. The PACI emphasized its role in protecting the Omani heritage and traditional cultural knowledge from imitation and misappropriation. This creates imbalance in production and quality. An example of a challenge was seen in the Omani Kema[7]. where production of machine Kema from other eastern countries has affected the quality and workers in that field. Technological integration must not be a threat facilitating unauthorized reproduction and unfair competition that could affect the value and quality of Omani crafts. Technological integration must not facilitate traditional knowledge, know-how skills and "craft trade secrets" release to international public.

As there is no international standard clarifying the percentage of machine use in handicraft making, one of the principals insists that in order to protect the practice, the integration of technology in craft making should not exceed 40% whereas 60% of the making process should be manual. The duty expected from Omani researchers and information technology specialists is to find solutions to integrate technology but without destroying Omani cultural expressionism and value.

The Third Meeting. This focused on highlighting the importance and national scope of integrating technology in handicraft making.

---

[7] -Kema is the national and traditional headdress worn by men in Oman
http://www.shabiba.com/article/139973/ (accessed 17/6/2016)

The PACI emphasized that studies focusing on the integration of technology in traditional handicraft training are necessary for craft making continuity. These should be conducted on the national level and should address the possibilities of including the findings and applications in national curriculum and syllabus, and the programs of "Al-Ajyall" college. The meeting highlighted the points discussed in the second meeting and explored the possibilities of getting fund for the research activities and technological implementation.

## 4  Discussion

The discussion will first focus on the position of PACI towards technological implementation in traditional handicraft training and second on the required implementations and projects.

### 4.1  PACI Position of technological Implementation in traditional handicraft training

The outcomes from the meetings and discussions with the PACI in relation to the integration and incorporation of technology in craft training have two edges. The first one, a resistance to technological implementation in handicraft context, related to the work politics and morals discussed in the literature review, is detected. However, new hazards and risks are also realized in relation to the role that might be played by the technology in challenging the IPR through the facilitation of misappropriation and unauthorized production that could lead to the globalization of "traditional knowledge" and reveal the cultural "craft trade secret". The Omani object has a national value that has affective relationships with its culture and people.

The second edge is the potentialities brought by technological adaption in preserving the "traditional knowledge" and the "craft trade secrets" from being lost forever and the possibility of transmitting them from one generation to the other one. This becomes crucial especially as the number of the experts in handicraft practice decreases continuously.

Within this focus the PACI departs with sustainability models proposed by the industrial models found in the literature review. Here, it tries to sustain the "traditional knowledge" and the "craft trade secrets" through the practice and process of hand making. The time-consuming hand making practice creates ways of perceptions, emotions and values that deepen the relationship between the generations, thus, sustaining a network of the past, present and future

of nationalism. Then, the sustainability and continuity of nationalism and its integrity emerges through that "romantic view" - as called by advocators of the industrial models [17]- of handicraft making.

The conflict between the challenges and potentialities of integrating technology in handicraft practice and training reveals that the technology might destroy that what it is set to preserve in the first place: "traditional knowledge" and the "craft trade secrets".  This means that a 'limit' in applying technology in handicraft practice should be set as a standard or a rule in order to protect handicraft making particulars in the training stage which could result in financial impacts that improve the handicrafts marketplace.

## 4.2 General Possibilities for Technological Implementation in Omani Handicraft Training

The previous reviews shows us the implementing technology in traditional craft training requires careful planning and decision making with a clear vision of future direction. This is critical especially with the model used by PACI that roots craft training model of the new generation on cultural expressionism and national heritage. The PACI traditional training model and academic programs wouldn't be able to maintain the relationship between old and new generations and to sustain craft industry without the incorporation of technology. The question becomes then how to protect the tacit knowledge, the ways of cultural understanding and expressions, and the affective relation between the generations and heritage while incorporating technology.

 Incorporating and/or integrating technology in the Omani craft education could be studied in relation to these three general sections:

**Philosophy of Technology and Embodiment**.
This critical context of handicrafts requires the integration and adaptation of technology in a way that sustains crafts' skillful practice without wiping its main constituency, and threatens its traditional knowledge and secrets. To achieve this, a philosophy or theory of embodiment is crucial because it emphasizes the role of the body in affection and perception while technological development and integration. An important concept that could be applied here is "transduction" of crafts and crafts industry.

Transduction means the a discovery of dimensions that are made to communicate by the system for each of the terms such that the total reality of each of the areas' terms can find a place in the newly discovered structures without loss or reduction [25].

In this sense, communication is effected between the heterogeneous terms where the latter preserve their singularity and at the same time forms relations with each other. Transduction becomes a resolution to the conflict between technological advances, and craft politics and practices which in Omani culture forms a symbol of national heritage. This should start by identifying those dimensions where technology could be integrated in the Omani traditional craft training model, adapted by PACI, without craft practice loses its constituency or gets overcame by technological tools.

**Blended/E-learning Infrastructure Development.** Developing the infrastructure requires a project-based plan for the e-learning development, production and management. This should take into consideration the development of the electronic content for crafts, and learning management systems. The theoretical content could be developed faster than the practical aspects. The production process could initially start by collaborating with each craft-based center(s), craft instructors and students to prepare the content, which is usually called the "scenario", to develop courseware models and materials [19]. Then transfer it to multimedia and web-based while developing authentic material and object libraries. These forms seem to provide communities of practice that supports learning as well as motivating and enhancing the learning of novice learners [31]. A management system and advanced learning tools could be developed at a later stage.

**Simulation Technologies.** This term is used here to refer more to advances in technology related to 3D environments, which require modelling and interactive techniques. Examples of these are simulations, virtual environments and games. These form the focus of current development and research interests in learning environments with manual manipulation and tacit performance. Developing simulation environments and mobile applications is expected to optimize the sustainability of the traditional crafts and Omani identity especially among younger generations. This requires more advanced software than the first area.

As craft practice is embodied and is based on tacit knowledge of practice, basically the precise and complex movements and measurements of human body, especially hands, it requires more than a visual representation of the making process. In other words, it requires the capturing of the "making" itself as an embodied act which includes the capturing of human movement, motion measurement, and body force or power output (i.e. using motion captures and sensors). Data captured through MoCap is based on real-time tracking and thus provide more realistic movement and experience. It can then be analyzed or/and modelled using 3D software.

Importantly, to achieve the objectives of the PACI training program, the technology should play a supportive role, and should be used to maximize the individualized learning performance during the engagement with the material/medium/object (e.g. giving feedback, indicating influencing factors … etc.). Technology should not be incorporated to replace human practice or skill or automate the handicraft making process.

## Roles of the technological integration. Technology could be used for:

Identification and documentation of the skillful habits of the Omani craft people. This is important to preserve these "know-how" practices in more accurate forms.

Development of training and learning tools for optimizing the performance of the new generations. Systematic data should be captured for reflection, analysis and sharing. This data could be used in creating human-machine interaction for training purposes. This requires the planning of intervention technologies that could support the learning of these habits. The PACI has conducted a documentary study, leaflets and video recordings to document the process through illustrations. A recent attempt by [32] to document the form and function of the incense burner has shifted direction to new methods of documenting the crafts work in recorded interviews with the crafts women from the Governorate of Dhofar explaining their craftsmanship and how the knowledge of making- the know-hows-transduced to them from their ancestors were conducted. [32] has recorded hundreds of hours of high definition videos of the complete process of making the incense burner by craftswomen which has emphasized the need to document the making of the cuboid itself.

Such an attempt, although not originally intended for situated-based technology interventions, presents an opportunity for basic means of crafts making perseverance and sustainability of know-hows of this specific craft work which can be applied to other craft work.

## 5 Conclusions

Handicraft marks one of the most resistant cultures for technological implementation in the current postindustrial world. In order to leverage technological use and sustain handicraft practices through technology a communication process between information technology specialists and handicrafts experts and principals should explore the challenges and potentials of such integration.  In the Sultanate of Oman, the PACI values traditional models of education and training based on hand making. These practices sustain the understandings of the Omani culture, nationalism, "traditional knowledge" and "craft trade secret" between generations. Although technology might improve craft marketplace and its financial impacts, it might destroy these particular ways of cultural understanding, skills, national emotions and expressionism. Technology, then, should be integrated within limits in the handicraft making process. Future work should focus on exploring these limits and technological implementations.

## Acknowledgment

## References

1. Adamson, G.: Thinking Through Craft, Oxford, New York, REG (2007).

2. Al-Ghilaniya, N., Al-Hamadan, W., Al-Bulushi, Z., & Al-Maqarshi, A. W.: Craft empowerment, Craft Horizons, Special issue, the tenth Omani craftsmen day, pp. 40--41 (2013a).

3. Al-Ghilaniya, N., Al-Hamadan, W., Al-Bulushi, Z., & Al-Maqarshi, A. W.: Special interview with HE Al-Sheikha Aisha bint Khalfan Bin Jameel Al-Siabiah, Head of the Generl Authority for Handicrafts, Craft Horizons, Special issue the tenth Omani craftsmen day, pp. 4--10 (2013b).

4. Al-Ghilaniya, N., Al-Hamadan, W., & Al-Shukaily, S.: The authority launches new electronic services Craft Horizons, pp. 36--47 (2012).

5. Anisef, J., Crafts sector review: Final report - Asset7095.aspx, http://www.arts.on.ca/Asset7095.aspx?method=1, (2010).

6. Bennett, S., Maton, K., & Kervin, L.: The "digital natives" debate: A critical review of the evidence British Journal of Educational Technology, *39*(5), pp. 775--786 (2008).

7. Brynjolfsson, E., & McAfee, A.: Race Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy, Lexington, Massachusette: Digital Frontier Press (2011).

8. Dormer, P.:Crafts and the Turing test for practical thinking,in P. Dormer (Ed.), The Culture of Craft: Status and Future pp. 138--157, Manchester University Press, New York, (1997)

9. Expanded Programs for Craft in Ontario. (n.d.), from http://www.arts.on.ca/Page4324.aspx

10. Fraser, M.: Lab Craft: Digital adventure in contemporary craft (Gallery Guide). UK: A Crafts Council Touring Exhibition http://www.labcraft.org.uk/_downloads/Lab-Craft-galleryguide.pdf, (2010).

11. French, N.: CADCAM and the British ceramics tableware industry, in P. Dormer (Ed.), The Culture of Craft: Status and Future pp. 158--167, Manchester University Press, New York, (1997).

12. Greenhalgh, P.: The History of Craft, in P. Dormer (Ed.), The Culture of Craft: Status and Future pp. 20--52, Manchester University Press, New York, (1997).

13. Houghton, N.: Craft Education: What it is, Where it Comes From, Where it's Going, http://mfarchive.plymouthart.ac.uk/journalvol2/pdf/Houghton_Nicholas.pdf, (2011).

14. Jewell, C.: A treasure-trove of Omani crafts, WIPO Magazine, 6, pp. 18--19 (2010).

15. Kheng, S., Ngo, J., & Amadhaj, H.: Sustaining the Magnificent Craft of Songket Weaving in Malaysia, http://digitalcommons.unl.edu/tsaconf/41, (2010).

16. Lynch, G. C.: Putting Value Back Into Craft Education. Forum Journal, *19*(4), pp. 30 (2005).

17. Malins, J. P., Press, M., & McKillop, C.: Craft connexity: developing a sustainable model for future craft education, Robert Gordon University, (2004). Retrieved from https://openair.rgu.ac.uk/handle/10059/620

18. Marshall, J.: Craft and Technology. Presented at the Craft in the twenty-first century: theorising change and practice, Edinburgh School of Art, (2002). Retrieved http://repository.falmouth.ac.uk/433/1/craft%20and%20technology%20marshall.pdf

19. Osman, S., Zin, N. A. M., & Norazinah, A.: New model for teaching and learning traditional craft courseware: Analysis and design phase, Journal of Theoretical and Applied Information Technology, *40*(1), (2012).

20. PACI.: Omani Crafts: A Documentary Study. PACI, (2014).

21. Prensky, M.: Digital natives, digital immigrants part 1, On the Horizon (MCB University Press), *9*(5), pp. 1--6 (2001a).

22. Prensky, M.: Digital Natives, Digital Immigrants Part 2: Do They Really Think Differently? On the Horizon (NCB University Press), *9*(6), (2001b). Retrieved from http://dmc122011.delmar.edu/sumacademy/sumacademy05/prensky2.pdf

23. Ricci, M.: New Technologies and Handmade Craft, The Craft Report, Business Wise (n.d.). Retrieved from http://www.craftsreport.com/business-basics/105-new-technologies-and-handmade-craft.html

24. R.I.T, Rochester Institute of Technology.: Creative Synergy: Technology blurs the line of making (n.d.) Retrieved July 14, 2015, from http://www.rit.edu/showcase/index.php?id=229

25. Simondon, G.: On the mode of existence of technical objects, University of Western Ontarion, London, (1980).

26. Simondon, G.: Technical Mentality, Parrhesia, *7*. Retrieved from http://www.parrhesiajournal.org/parrhesia07/parrhesia07_simondon2.pdf, (2009).

27. The PCAI.: Work Paper Axes, Retrieved from http://www.paci.gov.om/English/Papers_en/Paper2.pdf, (n.d.).

28. Treadaway, C.: Digital crafting and crafting the digital, The Design Journal, 10(2), pp. 35--48 (2007).

29. WIPO.: Intellectual property & traditional handicrafts. WIPO. Retrieved from http://www.wipo.int/tk/en/resources/handicrafts.html, (n.d).

30. WIPO & PACI.: International technical symposium on intellectual property and sustainable development: Documentation and registration of traditional knowledge and traditional cultural expressions, Retrieved from http://www.wipo.int/edocs/mdocs/tk/en/wipo_tk_mct_11/wipo_tk_mct_11_inf_7.pdf (2011).

31. Wood, N., Rust, C., & Horne, G.: A Tacit Understanding: The Designer's Role in Capturing and Passing on the Skilled Knowledge of Master Craftsmen, International Journal of Design, *3*(3), pp. 65--78 (2009).

32. Zimmerle, William Gerard.: Aromatics of all kinds: Cuboid incense burners in the ancient Near East from the late Third to the late First Millenia BC, (2014).

33. المنجي،ٍ. ب. س. ب. س. (٢٠١٤). الصناعات الحرفية العمانية (تطويرها البحوث والدراسات الفائزة بجائزة السلطان قابوس للإجادة الحرفية In. )تسويقها شركة مطبعة .(101–17 st ed., pp. في مجال البحوث والدراسات ٢٠١٠ (١ عمان ومكتبتها.

34. Shakya A. (2017) Handicraft Tourism : A New Way to Connect Tourism and Tradition. New Business Age. http://www.newbusinessage.com/MagazineArticles/view/1880 . Accessed 24/10/17

35. Shushma H. (2012). Tourism and Handicraft – Exploring the Linkages. Spectrum: A Journal of Multidisciplinary Research Vol.1 Issue 6, September 2012, ISSN 2278-0637.

36. International Trade Centre, (2015) Inclusive Tourism: Linking the handicraft sector to tourism markets. Genvea. http://www.intracen.org/uploadedFiles/intracenorg/Content/Exporters/Sectoral_Information/Service_Exports/Tourism/Linking%20the%20Handicraft%20Sector%20reprint%209%2010%202012%20for%20web.pdf Accessed 24/10/17