

3D Photogrammetry as an Aid to Traditional Canoe Building

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ABSTRACT

A renaissance in traditional boat building is occurring in Oceania but in some locations ancestral canoe designs are likely lost and so the body of knowledge supporting this renaissance is narrower than in its heyday. Traditional sailing and canoe building skills began to decline initially through colonialist pressure and accelerated in the 20th century with adoption of western values and the introduction of the outboard. This outside pressure has left a break in the chain of local knowledge surrounding canoe design and construction. It is possible that recent resurgence of traditional craft will provide a path to an accurate recreation of local purpose crafted canoes. A powerful and effective tool to ensure skills are passed on, and which can encourage comparative studies between builders, is the use of 3D photo scanning. As Oceania looks to alternatives to fossil fuels for transportation throughout the area traditional sailing techniques and design may have greater purpose for Oceania in development of sustainable transport. 3D photo scanning can help with sharing design ideas on sustainable transportation while aiding to track the connection with the past and future design constructions. With 3D scanning techniques, even if we can't save all existing older craft, we can capture what they are now and preserve the history before it literally rots away outside somewhere. 3D scanning and photogrammetry can provide an educational platform for schools, the public, traditional boat builders and offers a venue for showcasing traditional craftsmanship as an educational tool. The availability of 3D scanning can offer a record of how boats are being tweaked in the resurgent craft of traditional canoe as it evolves. Through this discussion the author hopes to share 3D scans conducted in Micronesia, gain insight from other like-minded individuals and network for a larger project of capturing digital records of Oceania's traditional canoes.

Key Words: 3d photogrammetry, Oceania, boatbuilding, sustainability

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INTRODUCTION

The scope for this discussion is centered on the development of a "Database for Traditional Canoes of Asia-Pacific Region" and the promotion of continued efforts to capture and promote traditional skills in canoe building. A decline in traditional canoe usage in Asia-Pacific has been spreading with the influence of western technologies in the form of fiberglass boats and outboard gasoline engines. Modern fiberglass boats continue to replace traditional craft throughout the region where and when gas is available and affordable. This impact is not without a resultant loss of knowledge and skill for both method and design of voyaging canoes throughout Oceania. The introduction of cash economies and surging emigration from island communities to urban centers constitutes that present and future continuation of such traditions as canoe building and navigation must be deliberate (Kan-Lun Tu, 2017). The decline began prior to the introduction of fiberglass boats and as Eric Metzgar points out, small pockets of skilled craftsman survive due partly to the delineation of

the Trust Territory of the Pacific Islands established by the United States under United Nations mandate. Unfettered by geopolitical boundaries, Micronesia islands were, and still are, culturally similar, speak dialects of the same language, and intermarriage between the populations on nearby islands remains common. The need for social economic exchange remains paramount for pockets of small low islands throughout Micronesia. With government ship service infrequent, social exchange predating political boundaries has been dependent on contact via community seacraft. Since motorboats are a prohibitively expensive option for making round-trip journeys in these areas voyaging canoes and associated knowledge of ocean navigation has been able to survive and has remained to fill the gap. This may have been essentially what saved traditional knowledge on voyaging (Metzgar, 2006). In earlier colonial times the banning of inter-island canoe travel by European administrations represented the beginnings of ocean voyaging decline. Voyages were forbidden, for instance, in the Caroline's in German times, and continued later under Japanese rule (Lessa, 1950). That traditional canoe building remains a fragile body of knowledge with several small pockets or closely held details remaining at risk was recently highlighted by the very near total loss of the skill of pandanus sail weaving. When sought out for a voyage to Guam prior to FestPac 2016 it was discovered that this skill was retained by a single individual. The Lamotrek canoe organization "Waa'gey" was able to enlist the help of 95-year old Maria Labusheilam, the last master weaver in Lamotrek who, led by her daughter Maria Ilourutog, taught the skills to 20 women apprentices. The men of Lamotrek, led by Xavier Yarofaliyango, cut the pandanus leaves, and stretched and stitched the sail together in preparation for weaving. Maria Labusheilam died two weeks after passing on the knowledge and she did not see the final outcome of her work. The entire process of weaving the sail took more than six months, with over 30 people contributing to its construction. Through her ability alone this craft lives on.

In Oceania a renaissance in canoe building is commonly associated with a canoe journey in 1969 from Puluwat to Saipan by the navigator Hipour (Lewis, 1972). The presence of a revival which has been slowly growing since 1969 does not mean that the future is secure or that pockets of knowledge may not continue to be lost. It is for this reason that a database of Asia-Pacific traditional canoes may be of value into the future. It is hoped that this database would be maintained within the academic world and accessible by traditional canoe builders and historians with an interest in further preserving the knowledge and craft. In many cases the intent is to recreate the identical craft of the ancestors. At times this task is impeded by the break in the continuous handing down of information and an absence lack of documentation as information was previously passed through generations through hands on practice and oral tradition. In these cases the knowledge base could continue through the support of a database with increasing reawakening as the present day crafters move forward each day. This is the area where I feel new technology can assist in connecting with the old ways.

Recent discussions between the author and Larry Raigetel, Waa'gey Org., on the effect the use of outboard motorboats has been having on long established community norms regarding shared resources on small islands revealed an uneasy coexistence between the old and the new. With traditional canoes the community benefits from the activities undertaken in by the canoe. With fiberglass boats, the boat and motor are usually considered owned by one or two individuals. Likewise, the gas is typically bought by the owners. This has an altered effect on the sharing of

resources on islands where communities operate in a more sustainable fashion. How the catch is divided, along with when and for what purpose the gas is used has become an issue of who bought the gas and means that clarity over who gets the greatest share of the catch and what the boat will be used for becomes less clear when who is paying for the gas and boat is factored in. The benefit of the entire community is less understood by the island and could affect previously understood patterns for sustainability on small islands. Presently, due to the cost and availability of gas, on most small Micronesian islands there are only a few months that motorboats can be used. The rest of the year the fiberglass boats and motors are put away and the canoes are pulled out of the canoe houses and put back into service as the community returns to the traditional canoe for fishing or trade with sharing practiced in the same fashion it has always been. Still there remains an uneasiness within many communities and within the canoe house about how these issues will be resolved should the fiberglass boat and outboard become the norm.

Along with the obvious activities of canoe building, design and the vast knowledge of navigation, the act of seafaring of itself contains a wealth of knowledge regarding the natural environment, ocean currents and weather patterns. Throughout Oceania routes and sailing instructions were learned and recited in chants commencing from childhood. These chants contain details of not simply just the charted path, but also contained the spirit of the people, their relationship with other islanders and a wealth of information on the natural world around them. In his paper Diaz indicates that chants such as “Ufi Mwareta”, which literally means “women weaving mwar”/ head leis” were systems of mnemonics describing the seaway between islands (Diaz, 2011). Through the chant names of sea creatures, islands, and watermarks passed from generation to generation. As an example, the chant says to look out for ikelap – the big fish - which, when sighted, indicates you are east of Guam, the southernmost island of the Marianas archipelago. Diaz explains these are the “superficial” or surface meanings but that there are also deeper meanings in the chants. While the surface meaning is the literal, the list of creatures, stars, reefs, waterways, landmarks, and flora which constitute a veritable mnemonic map of the route from the Central Carolines to the Marianas. But there is also a deeper meaning which is one of metaphor that links cultures, credits the names of canoe parts and describes much deeper relationships between peoples and islands.

The skill of seafaring has come very close to being lost through the policies of outside governments and rapid modernization and is directly linked to the act of canoe building. As mentioned previously, both German and Japanese colonial powers banned voyaging as a means of control. At that time the Japanese, alarmed at the downward trend in population and the great expense incurred in repatriating men lost at sea, forbade all travel between islands. Additionally, geopolitical boundaries were established that did not consider traditional island to island relationships (Lessa, 1950). The lack of regular service by supply ships, the high cost of gas for outboard motors and the exclusion of travel to islands that held strong kinship ties with each other are possible reasons why the art of canoe building and navigation didn’t become lost altogether as travel in remote areas continued anyway. That is not to say that much was not lost. On Yap island five types of canoes were known to exist, the Popow (popo), Chuggin (Chukhpel), Gawel (Hawel), Thowaab, and Bulel (Bangrow). Of those the Gawel, Thowaab and Bulel no longer exist and although a single Chuggin was built in the 1990’s, knowledge of the others has been lost (Kan-Lun Tu, 2017). In the Marianas, the Sakman is being built based entirely on the Anson Drawings of 1742, drawings which

were made from a disassembled canoe. As local knowledge has been completely lost, questions over its assembly and fitting out, remain in debate as local craftsman try to reconstruct Sakman canoes today. The Sakman may well have been the most advanced sailing vessel up to the introduction of modern materials in boat building.

The loss of seafaring could mean the outside world of \$10/gallon gasoline, fiberglass boats and government transportation will preside in the future ever increasing dependence on the outside world. For many islanders, the dependence on modern equipment, boats, and motors, is already making the cost of living a subsistence life the nearly prohibitive to work even the local reefs. So much of the local catch has to go to buying gas that the cost of continuing contact with other islands is becoming out of reach. Should climate change or natural disasters occur it is entirely possible that governments will decide what islands are viable for habitation and which are not, and in doing so may no longer provide support for the affected islands, purely as a cost cutting measure. Without the knowledge of seafaring and canoe building the locals may well be at the determination of others for sustainable living on their home islands vs self-determination.

The differences of sailing canoes are subtle but they are many. A fixed mast or one supported by sennet. The degree of asymmetry of the hull. Strait or curved outrigger booms. Lee platforms or not. All of these differences in design and rigging are somewhat geographically defined. They are all products of evolution and that evolution occurred through a need of a local phenomenon of weather or wave that gave it purpose, no matter how subtle the specific tweak or purpose change was. Presently with the renaissance of constructing voyaging canoes across the Pacific in full swing there are several new canoes being built each year. Some of the efforts are towards double hull canoes and incorporate the designs of the past with modern day materials. Others are engaged in building canoes which were more familiar to the home island or atoll. Each unique feature has purpose and may be an important consideration for future craft if it is fully understood.

The principal objective for the database is to collect spatial of individual canoes along with capturing the location, type, description, builder, custodian, materials, year built, and general comments for each. Expansion of the project could include capability for printing of highly accurate 3D models for further performance and design study. The inclusion of builders and organizations provides additional depth for researchers to draw on. The intent is not to aid evolution of design but to capture and validate design concepts of past builders and locales. That is not to say that the concepts could not be applied where the use of modern materials is being implemented to advance the Pacific experience for tourism or economic sustainability.

Support of spatial data collection through 3D photo scanning can offer a powerful and effective tool to ensure design skills are passed on and to supplement comparative studies between builders. As Oceania looks to alternatives to fossil fuels for transportation traditional sailing canoe design may assist development of sustainable transport craft based on ancient design principles. 3D photo scanning can be used to both aid in tracking the connection with the past and providing comparative data for future design. With 3D scanning techniques, even if we can't save all existing older craft in late stage of deterioration, we can capture what they are now and preserve the history before it literally rots away outside somewhere. In this presentation I will show several examples of 3D photogrammetry to demonstrate its effectiveness as an educational platform for the public, schools,

traditional boat builders and for museums to showcase traditional canoes. This presentation will demonstrate how the use of 3D scanning can enhance information on past design and offer a record for boats being tweaked through progression in today's traditional canoe building practice.

DATABASE SCOPE

Most traditional canoes in Asia Pacific were built by canoe builders either for their own use or for use in trade. In recent years, some builds have been commissioned by museums or private entities. Details on the construction, ownership or transfer of individual canoes is rarely kept except as individual knowledge by those who are most intricately connected to the canoe and retained only through oral history by those closely associated to the building of the canoe or the builder's family. Several resources used in this report and identified in the bibliography have been used to identify the canoe types and the location for those particular canoes already added to the database. The main records in the database are broken down as canoe, canoe type, builder and custodian/owner. The database is provided as a working tool to expand and capture information as canoes, canoe types, builders and custodians are identified.

To aid in expanding on conceptual representation of individual canoe types as beyond just an internet search for a representative drawing of a particular canoe, it is desirable for the database to have a photo of the canoe wherever possible, and within the authority of any copyright. Eventually it would be desirable to advance the database onto a cloud-based server, and along with the data defined above, add with it a digital model of the canoe using 3D photogrammetry when possible.

In its present form the database is developed using Microsoft Access as a flexible tool to initially design the database capturing fields and relationships. It is planned that the database will be incorporated into a server in SQL format with several interrelated queries and forms to enhance its usability. With only four tables, the focus is relatively narrow and it is not anticipated that this complexity will not grow greatly. However, the vast amount of data in canoes, canoe types and the wide range of builders and regional names could see the database itself become quite large and for this reason authority to manipulate tables should be limited to those few who will oversee the database. As 3D scans are introduced the server space could become quite large and certainly beyond the capability of a cloud or single hard drive of typical user proportion.

The database is constructed of four tables, 1. Canoe Types, 2. Canoe_Main, 3. Builders and 4. Custodians/Owner. The basic relationship for functional testing is shown in the Fig. 1 below.

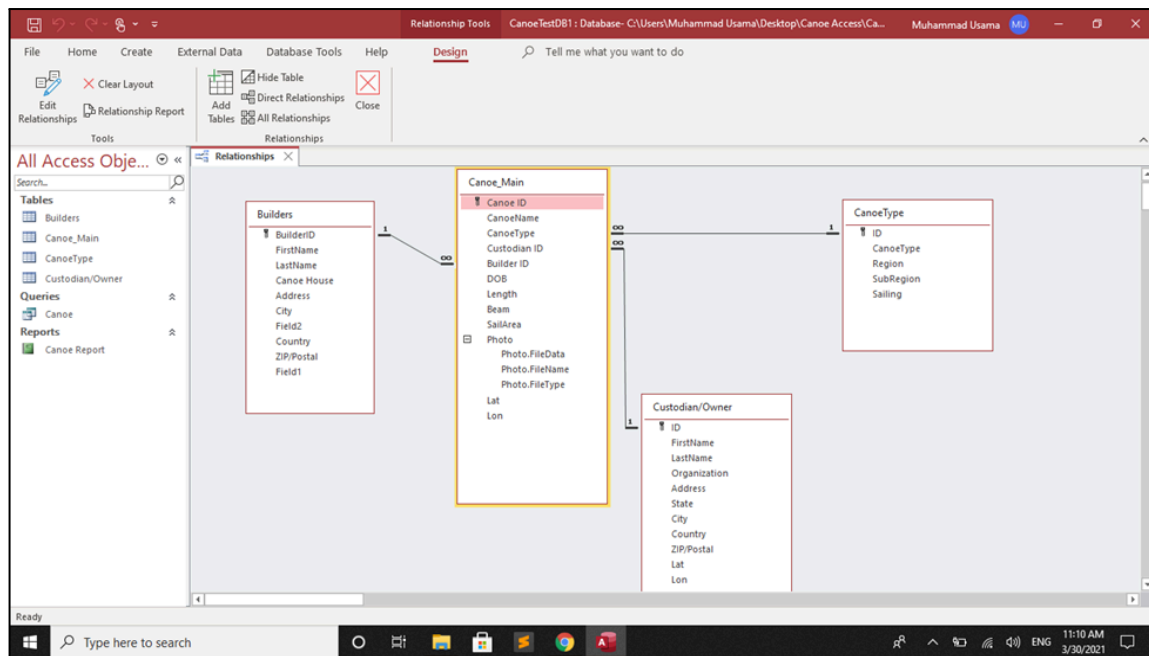


Figure 1: Relationships.

The structure is intended to allow searches whereby Builders may be identified for many canoes. Custodians may include the location of many canoes, and within the collection of a single custodian, individual canoes may be identified as one of many canoe types. This allows several search capabilities to find an individual canoe, all canoes at a certain location or all canoes by a particular builder to offer depth to the researcher utilizing the database.

In its present form the canoe types are identified as those identified and common to the Marianas Islands and Yap State. The canoes of Yap state have many names which are slight variations of the same canoe types. The local variation name is in parenthesis. (Fig. 2).

Within the field for “Canoe Types” there is a “Yes/No” record for separation of canoes which are most associated with traditional canoe build and predominantly constructed of locally procured materials from canoes of more modern construction and materials but inspired by traditional design. This is somewhat subjective and may vary by interpretation. For the purpose at this stage of the database specific details of nontraditional canoes it is expected that details for the designer, builder, materials, etc. should be captured in the “General Description” field of the “Canoe_Main” record. If the nontraditional field becomes large the database could be separated into two separate records for “Traditional” canoes and “Nontraditional” canoes. Most nontraditional canoes will typically be found at canoe clubs or with private owners, canoe clubs may also have multiples of one-design canoes.

ID	CanoeType	Region	SubRegion	Sailing
1	Sakman	Micronesia	Marianas	☒
2	Lelek	Micronesia	Marianas	☒
3	Duding	Micronesia	Marianas	☒
4	Duduli	Micronesia	Marianas	☒
5	Gallaide	Micronesia	Marianas	☒
6	Popow (popo)	Micronesia	Yap, Main Islands	☒
7	Chugpin (Chukhpel)	Micronesia	Yap, Main Islands	☒
8	Gawel (Hawel)	Micronesia	Yap, Main Islands	☒
9	Thowaab	Micronesia	Yap, Main Islands	☒
10	Bulel (Bangrow)	Micronesia	Yap, Main Islands	☒
11	Warwel (Waserek, Waserek, Warwar)	Micronesia	Yap, Outer Islands	☒
12	Waterage	Micronesia	Yap, Outer Islands	☒
13	Manibwel	Micronesia	Yap, Outer Islands	☒
14	Wafatiul	Micronesia	Yap, Outer Islands	☒
15	Shoasemalu (Shoasemal, Rhoael, Rhasemet)	Micronesia	Yap, Outer Islands	☒
16	Walap	Micronesia	Marshall Islands	☒
17	Tipinol	Micronesia	Marshall Islands	☒
18	Korkor	Micronesia	Marshall Islands	☒
19	Modern Design			☐
	(New)			☐

Figure 2: Canoe Types.

The main body of information on individual canoes along with links to location: Latitude (Lat); Longitude (Lon) and potentially links to 3D scans are stored in the fields of the Canoe-Main table. (Fig.3). The “General Description” is provided as a “long text” to capture all relevant information captured at the time of the of the inspection and/or entry. Color and materials added during refits or repairs can be added in this field, but it is entirely possible that these items may change through the life of the canoe. Long text fields will accept 64,000 characters, additional Memos can be added as required for up to an additional 65535 characters.

A single form has been generated for the Canoe Report based on the Canoe Main table (Fig. 4). Other forms can be generated depending on the needs of the researcher. It is assumed that this structure will be at the conversion to SQL format for a larger server. The functionality is available in MS Access, but it is in the larger purpose of adaptation into SQL that will require special attention to forms.

Canoe ID	CanoeName	CanoeType	Custodian ID	Builder ID	DOB	Length (m)	Beam (m)	Traditional	Lot	Lon	General Description
1	Ulita	1	1	2	1/1/2018	10	6		13.488889 N	114.791389 E	
3	Saina	4	2	3	1/1/2007	0	0		13.479167 N	114.751944 E	
4	Fanhighayan Gu	1	2	3		0	0				
(New)		0	0	0		0	0				

Figure 3: Canoe Main.

CanoeName	CanoeType	Length	Beam	SailArea	DOB	Latitude	Longitude	Photo	CFName	CLName	BFName	BLName
Ulita	Sakman	36	18		1/1/2018	13.488889 N	114.791389 E				Ron	Actalle
Saina	Duduli	0	0	0	1/1/2007	13.479167 N	114.751944 E				Frank	Cruz
Sema Makawa	Drua	24	8	75	1/1/1993						Sirilo	Raqatima

Figure 4: Canoe Report.

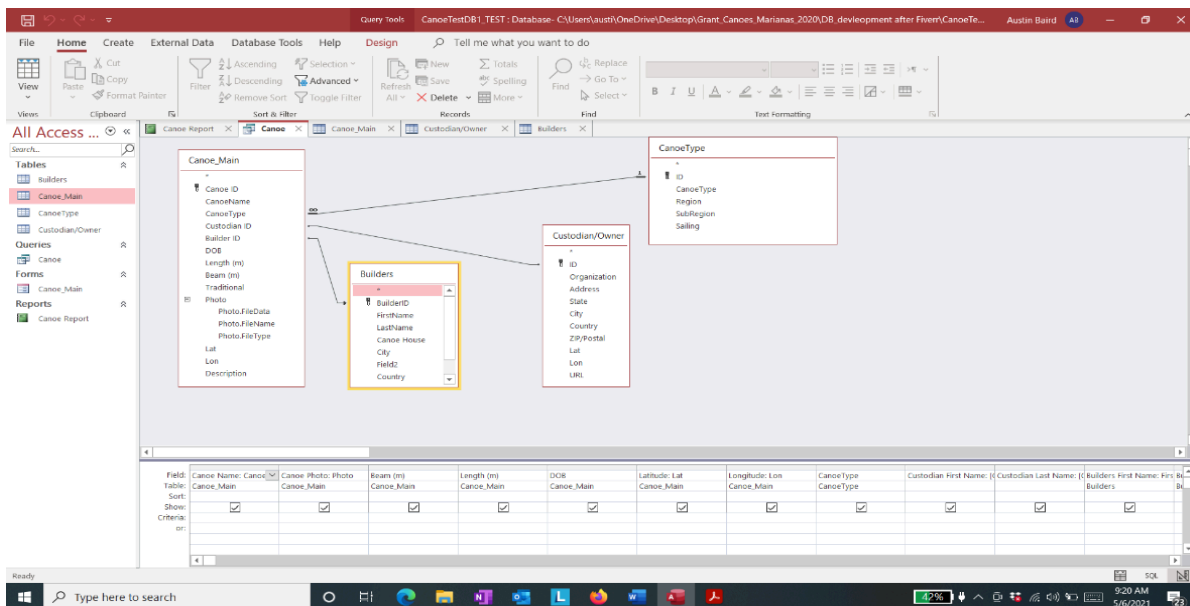


Figure 5: Relationships.

SUMMARY

The database is being developed to offer a working tool to expand on and capture information under the fields as canoes, canoe types, builders and custodians. Further data includes traditional or nontraditional, who made the entry and when. The purpose is to aid in the capture of data according to individual canoes, canoe types, builders and custodian/owner. The intent of the database is to provide a working tool to expand and capture information on traditional and traditionally inspired canoe as individual canoes, canoe types, builders and custodians are identified. The resource is hoped to be of interest to builders, academia and for naval architects/engineers.

In some Asia-Pacific locations traditional boatbuilding is being revived for cultural reasons. In others it is paired with a strive for more sustainable trade and transportation methods between islands. But in most cases both seafaring and canoe building, along with the vast associated oral history and craft skills that come with it, remains a fragile body of knowledge with several small pockets of closely held details remaining at risk throughout the region. The presence of a database could become invaluable into the future understanding of seafaring in the Asia-Pacific region should these valued attributes of the human experience further erode.

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