A New Wave of Prosopography: an Application to Tide Prediction Machines

Doodson-Légé tide prediction machine, built in London in 1950. Photograph taken by H. M. Rawsthorne at NOC, Liverpool, on 15/01/2019; licensed under CC BY 4.0.

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TIDAL PREDICTION

coastal dwelling

marine navigation

fishing

operating docks

operating ports

operating harbours

coastal surveying

coastal zone engineering

beachgoing

naval operations

watersports

commercial shipping

houseboat living

biology

building flood defences

tidal power

ecology

weather forecasting

$$H(t) = \sum_{i=1}^{i=N} A_i \cos(\omega_i t - \phi_i)$$

Tidal theory, analysis and prediction

- BCE: Indian and Arabic civilisations recognising link between moon and tides
- Middle Ages: rule-of-thumb methods linked to phases of moon
- Tidal theories: Copernicus, Bacon, Galilei, Kepler, Descartes, Newton, Laplace
- Tidal analysis and prediction: Lubbock, Young, Airy, Thomson, Ferrel, Darwin, Proudman, Doodson

British Tide Predictor No.1, built in London in 1873. Photograph taken by H. M. Rawsthorne at Science Museum, London, on 02/02/2019; licensed under CC BY 4.0.

The development of tide prediction machines

- Mid-19th century: commercial shipping lines calling for improved prediction service
- Calculations by hand no longer sufficient
- BAAS funded development of a machine to calculate tidal predictions
- First TPM designed by William Thomson, constructed in 1873 by A. Légé & Co. in London

Doodson-Légé tide prediction machine, built in London in 1950. Photograph taken by H. M. Rawsthorne at NOC, Liverpool, on 15/01/2019; licensed under CC BY 4.0.

What are tide prediction machines?

- Analogue computers used for calculating tidal predictions
- Outputs: times and heights of high and low tide
- Based on tidal theory and tidal equation
- Total of 33 ever built
- Used across the world
- Always operated on land
- Superseded by digital computers

Bidston-Kelvin tide prediction machine, built in Glasgow in 1925. Photograph taken by H. M. Rawsthorne at SHOM, Brest, on 18/12/2018; licensed under CC BY 4.0.

Significance of tide prediction machines

- Required development of scientific theory and of technology
- Crucial to advancement of marine transport: commercial and military
- Used for WWII Normandy landing operations
- Important for building modern ports and effective flood defences

PROSOPOGRAPHY AND DIGITAL HUMANITIES

Define group of people to be studied

Construct hypotheses and questions about group

Translate hypotheses and questions into questionnaire

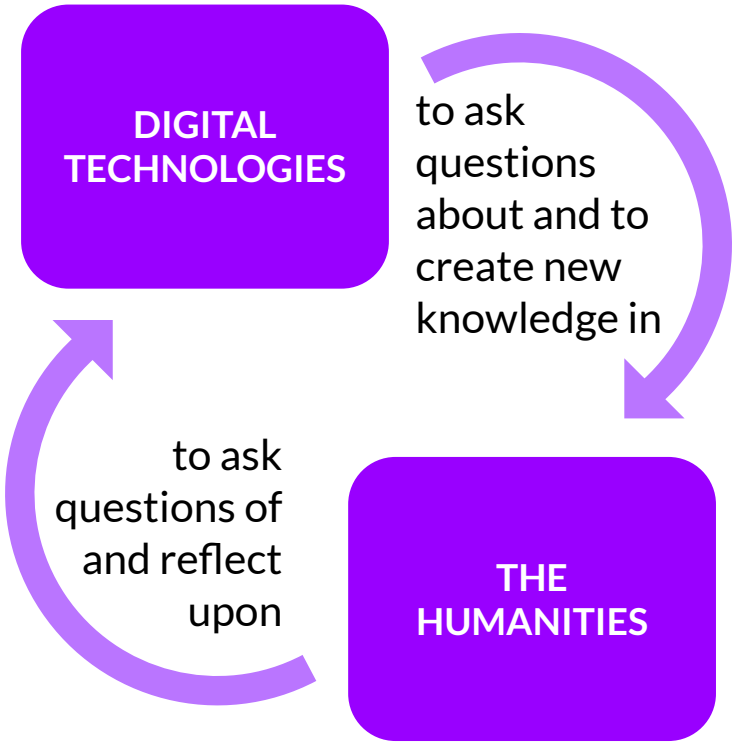
Use authoritative sources to answer questionnaire for every member of group

Create database of answers

Analyse data in database to answer initial questions

What is prosopography?

- Research approach usually used by historians to study the lives of groups of people
- Involves creating collective biography or gathering data about common aspects of lives of individuals within group
- Data can be compared, synthesised and analysed



What is digital humanities?

- Interdisciplinary area of study between humanities and digital technology
- DH digital technologies come in form of tools, applications and software (purpose-built for DH or not)

Tide prediction machines, prosopography and digital humanities: how do they fit together?

- Want to study “lives” of tide prediction machines as a collection of artefacts
- Going to adapt prosopography for study of artefacts
- Going to make use of digital humanities tools for data analysis

Define group of artefacts to be studied

Construct hypotheses and questions about group

Translate hypotheses and questions into questionnaire

Use authoritative sources to answer questionnaire for every member of group

Create database of answers

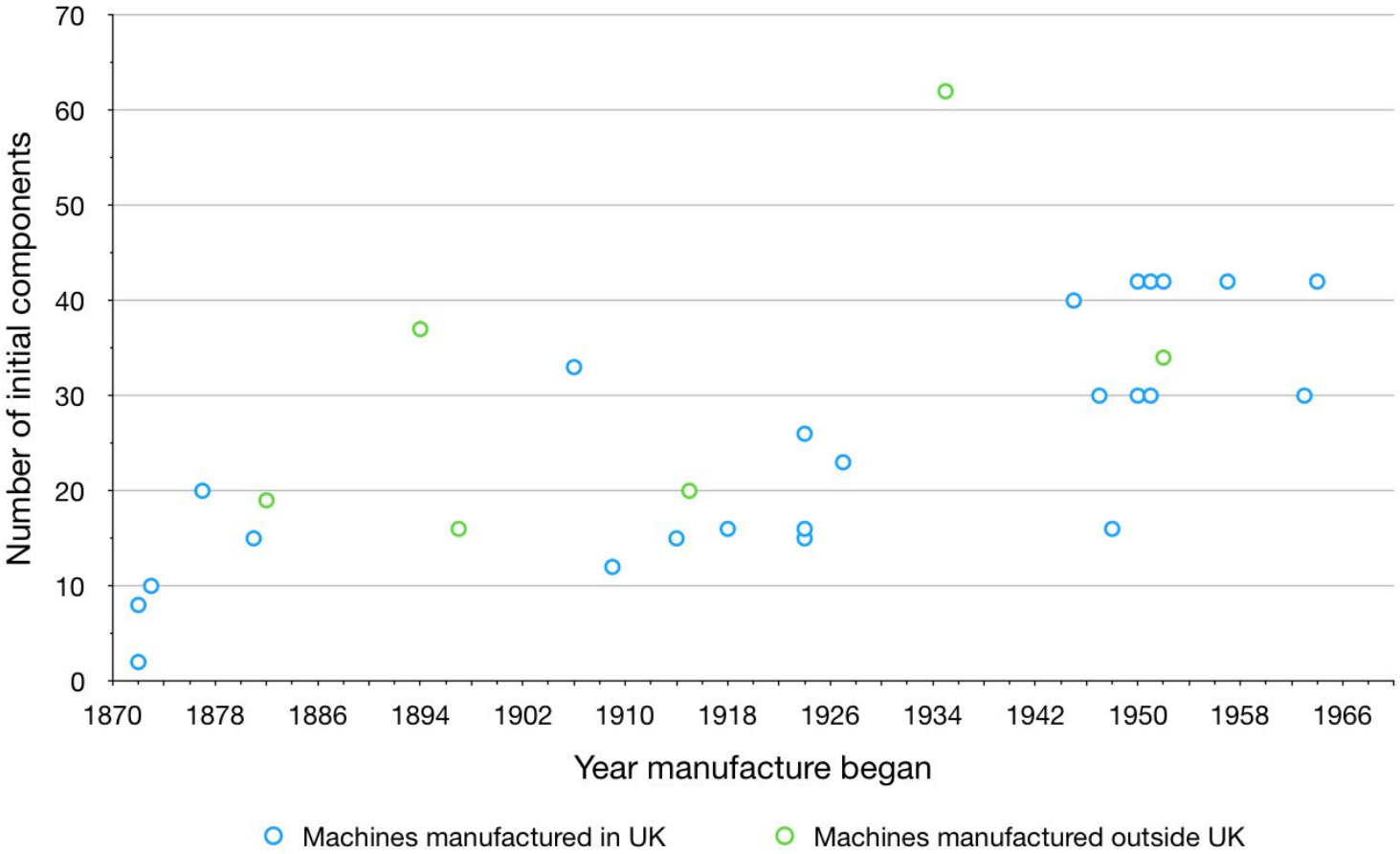
Analyse data in database to answer initial questions

Adaptation of prosopography

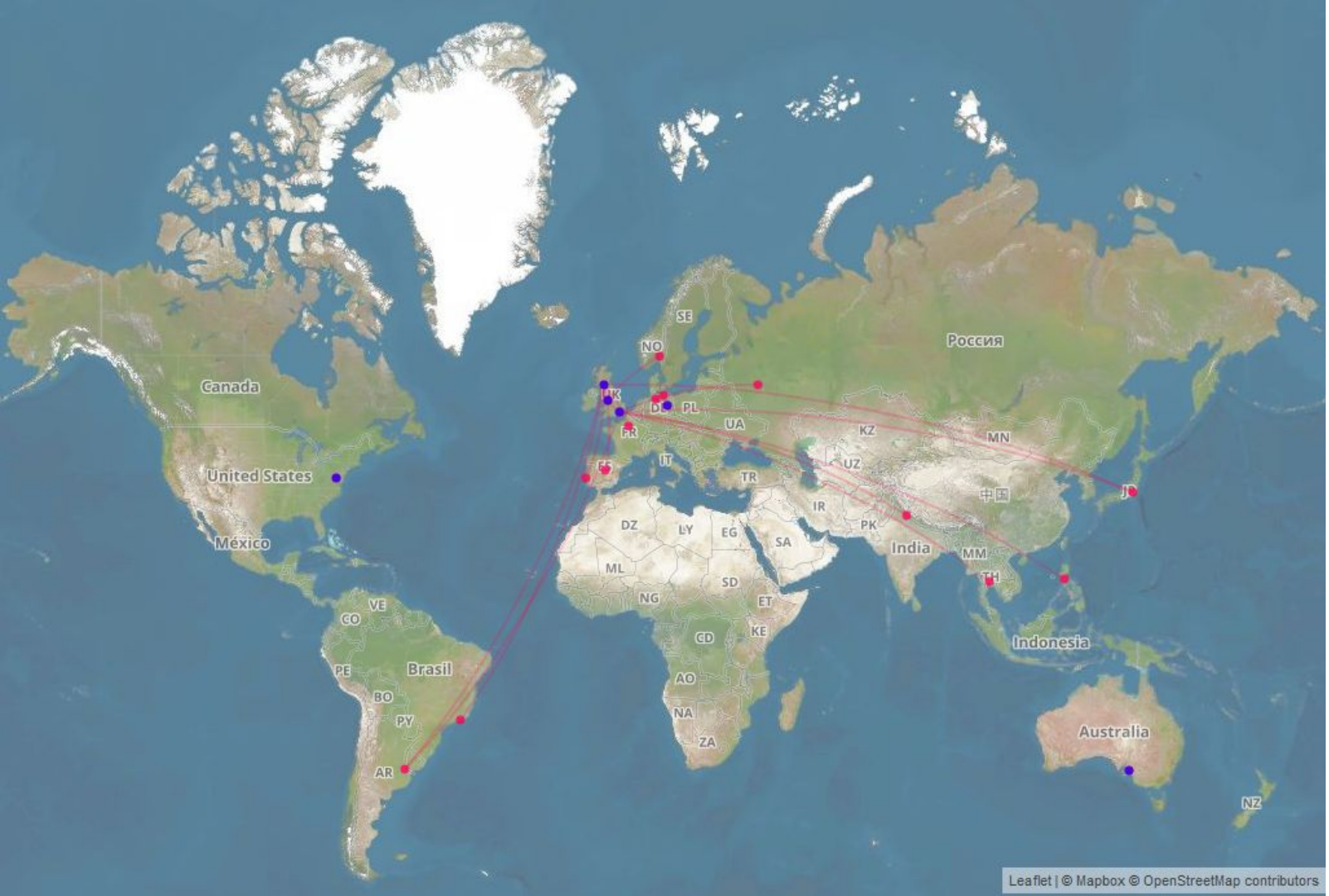
- Analogy between life of a person and existence of an artefact
- Each has a unique story to tell and is impacted by events and relations
- Can prosopography be successfully applied to study the “lives” of groups of artefacts?

Worldwide TPMs (inc. prototypes)

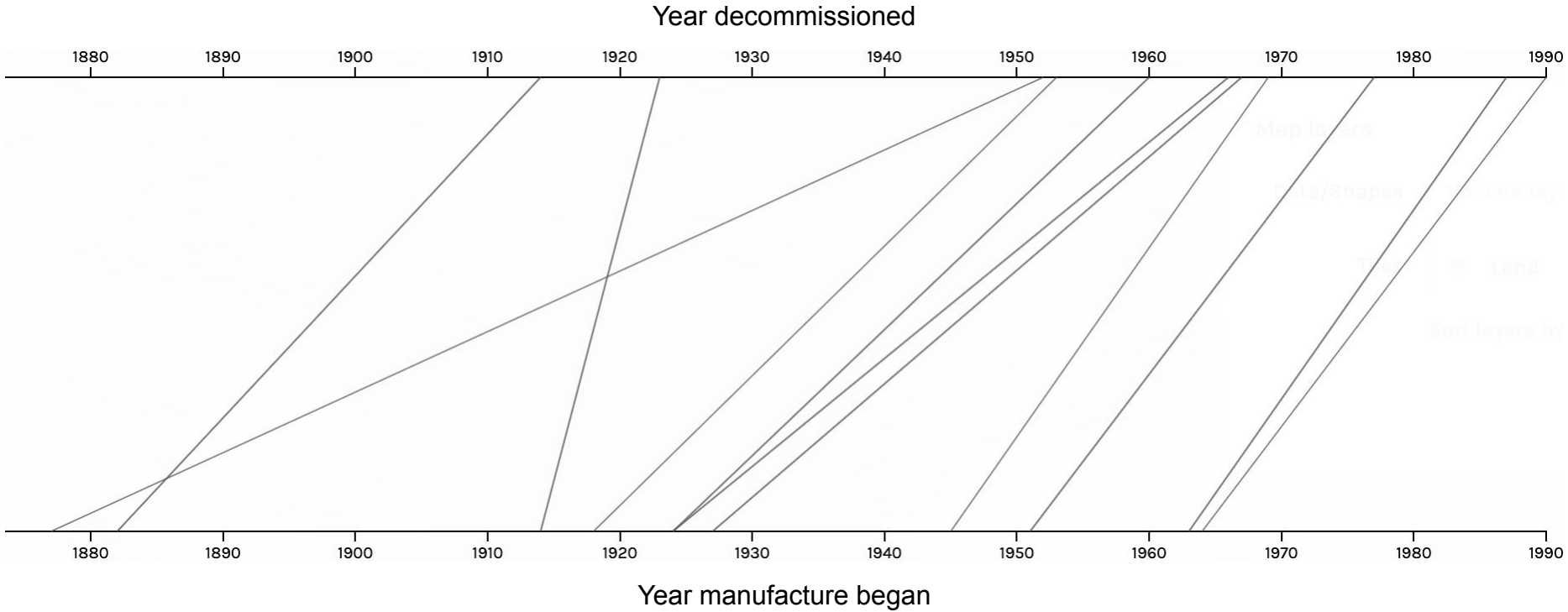
No.	Name	Prototype/ operational	Manufacture began	Manufacture finished	Manufacturer	City of manufacture	Country of manufacture	Initial number of constituents	Refurbishment year	New number of constituents	First operation city	Year moved during operation	Final operation city	Year decommissioned	Reason for decommissioning	Modern refurbishment year	Current owner	Current place	Current country	Current city	Current status
TPM-KP1	Kelvin Model made for the BAAS	Prototype	1872	1872	Messrs. White	Glasgow	UK	8							Prototype						
1	Kelvin's First TPM	Operational	1873	1873	Alexander Légé & Co.	London	UK	10			London		London				The Science Museum	Science Museum	UK	London	On display to public
TPM-KP2	Kelvin 2-Component Machine	Prototype	1872	1873	Alexander Légé & Co.	London	UK	2							Prototype						
2	India Office Machine	Operational	1877	1879	Alexander Légé & Co.	London	UK	20	1891	24	London	1921	Dehradun	1952	Replaced by newer TPM		Museum of the Survey of India	Museum of the Survey of India	India	Dehradun	On display to public
3	British TPM No. 3	Operational	1881	1881	Kelvin and White	Glasgow	UK	15	1901	16	Paris		Paris				Musée des Arts et Métiers	Musée des Arts et Métiers	France	Paris	
4	US & C&GS No. 1	Operational	1882	1882	Fauth and Co.	Washington, D.C.	USA	19			Washington, D.C.		Washington, D.C.	1914			Smithsonian National Museum of American History	Smithsonian National Museum of American History	USA	Washington, D.C.	In storage
TPM-X2	Australian TPM	Operational	1897	1897	Alexander Inglis	Adelaide	Australia	16			Adelaide		Adelaide								
5	Roberts-Légé Machine	Operational	1906	1908	Alexander Légé & Co.	London	UK	33	1936	40	London	1929	Bidston			2015	National Museums Liverpool	National Oceanography Centre	UK	Liverpool	Viewed by arrangement
6	US & C&GS No. 2	Operational	1894	1910	US Coast & Geodetic Survey	Washington, D.C.	USA	37			Washington, D.C.		Washington, D.C.			2015	National Oceanic and Atmospheric Administration	National Oceanic and Atmospheric Administration Science Center	USA	Silver Spring	Viewed by arrangement
7	British TPM No. 4	Operational	1909	1910	Kelvin and White	Glasgow	UK	12			Rio de Janeiro		Rio de Janeiro				Museu Náutico de Bahia	Museu Náutico de Bahia	Brazil	Salvador	On display to public
8	Japan Kelvin Machine No. 1	Operational	1914	1914	Kelvin, Bottomley and Baird	Glasgow	UK	15			Tokyo		Tokyo	1923	Accidental destruction						Destroyed
9	German TPM No. 1	Operational	1915	1916	Toepfer und Sohn	Potsdam	Germany	20	1931		Hamburg		Hamburg				Deutschen Schiffahrtsmuseum	Deutschen Schiffahrtsmuseum	Germany	Bremerhaven	On display to public
10	Argentina TPM No. 1	Operational	1918	1918	Kelvin, Bottomley and Baird	Glasgow	UK	16			Buenos Aires		Buenos Aires	1953			Observatorio Naval Buenos Aires	Observatorio Naval Buenos Aires	Argentina	Buenos Aires	
11	Japan Kelvin Machine No. 2	Operational	1924	1924	Kelvin, Bottomley and Baird	Glasgow	UK	15			Tokyo		Tokyo				Japan Coast Guard Academy	Japan Coast Guard Academy	Japan	Hiroshima	
12	Japan Kelvin Machine No. 3	Operational	1924	1924	Kelvin, Bottomley and Baird	Glasgow	UK	15			Tokyo		Tokyo	1960			National Museum of Nature and Science	National Museum of Nature and Science	Japan	Tokyo	On display to public
13	Lisbon Machine	Operational	1924	1924	Kelvin, Bottomley and Baird	Glasgow	UK	16			Lisbon		Lisbon				Instituto Hidrográfico	Library of the Instituto Hidrográfico	Portugal	Lisbon	On display to public
14	Bidston-Kelvin Machine	Operational	1924	1925	Kelvin, Bottomley and Baird	Glasgow	UK	26		29	Bidston	1950	Paris	1966	Replaced by digital computers		Service Hydrographique et Océanographique de la Marine	Service Hydrographique et Océanographique de la Marine	France	Brest	Viewed by arrangement
15	Brazil Kelvin Machine	Operational	1927	1927	Kelvin, Bottomley and Baird	Glasgow	UK	23			Rio de Janeiro		Rio de Janeiro	1967			Museu de Astronomia e Ciências Afins	Museu de Astronomia e Ciências Afins	Brazil	Rio de Janeiro	
16	German TPM No. 2	Operational	1935	1939	Aude und Reipert	Potsdam	Germany	62			Hamburg		Hamburg				Deutsches Museum	Deutsches Museum	Germany	Munich	On display to public
17	Russia Doodson-Légé Machine	Operational	1945	1945	Alexander Légé & Co.	London	UK	40			Moscow		Moscow	1969	Replaced by digital computers						Destroyed
18	Norway Kelvin Machine	Operational	1947	1947	Chadburns	Liverpool	UK	30			Oslo		Oslo				Stavanger Maritime Museum	Stavanger Maritime Museum	Norway	Stavanger	On display to public
19	Madrid Kelvin Machine	Operational	1948	1948	Kelvin and Hughes	Glasgow	UK	16			Madrid		Madrid				Instituto Hidrográfico de la Marina	Instituto Hidrográfico de la Marina	Spain	Cádiz	In storage
20	Bidston Doodson-Légé Machine	Operational	1950	1950	Alexander Légé & Co.	London	UK	42			Bidston		Bidston		Replaced by digital computers	2015	National Museums Liverpool	National Oceanography Centre	UK	Liverpool	Viewed by arrangement
21	Manila Doodson-Légé Machine	Operational	1950	1950	Alexander Légé & Co.	London	UK	30			Manila		Manila				National Mapping and Resource Information Authority, Hydrography Department	National Mapping and Resource Information Authority, Hydrography Department	Philipines	Manila	On display to public
22	India Doodson-Légé Machine	Operational	1951	1951	Alexander Légé & Co.	London	UK	42			Dehradun		Dehradun				Museum of the Survey of India	Museum of the Survey of India	India	Dehradun	Viewed by arrangement
23	Siam Doodson-Légé Machine	Operational	1951	1951	Alexander Légé & Co.	London	UK	30			Bangkok		Bangkok	1977			Royal Thai Navy	Thai Hydrographic History, Royal Thai Navy, Hydrographic Department	Thailand	Bangkok	On display to public
24	Argentina Doodson-Légé Machine	Operational	1952	1952	Alexander Légé & Co.	London	UK	42			Buenos Aires		Buenos Aires				Museo Naval de la Nación	Museo Naval de la Nación	Argentina	Buenos Aires	On display to public
25	German TPM No. 3	Operational	1952	1955	VEB Karl-Marx-Werk	Potsdam	Germany	34			Rostock						Deutschen Schiffahrtsmuseum	Deutschen Schiffahrtsmuseum	Germany	Bremerhaven	On display to public
TPM-X3	Japan Doodson-Légé Machine	Operational	1957	1957	Alexander Légé & Co.	London	UK	42			Tokyo		Tokyo				Hydrographic and Oceanographic Department, Japan Coast Guard	Hydrographic and Oceanographic Department Museum	Japan	Tokyo	On display to public
TPM-X5	Indonesia Doodson-Légé Machine	Operational	1963	1963	Alexander Légé & Co.	London	UK	30						1987	Replaced by digital computers						Destroyed
TPM-X6	Burma Doodson-Légé Machine	Operational	1964	1964	Alexander Légé & Co.	London	UK	42						1990					Myanmar	Yangon	
TPM-X1	Koenings' 4-Component Machine	Operational					France	4													
TPM-X4	Kobe Machine	Operational					Japan											Kobe University	Japan	Kobe	



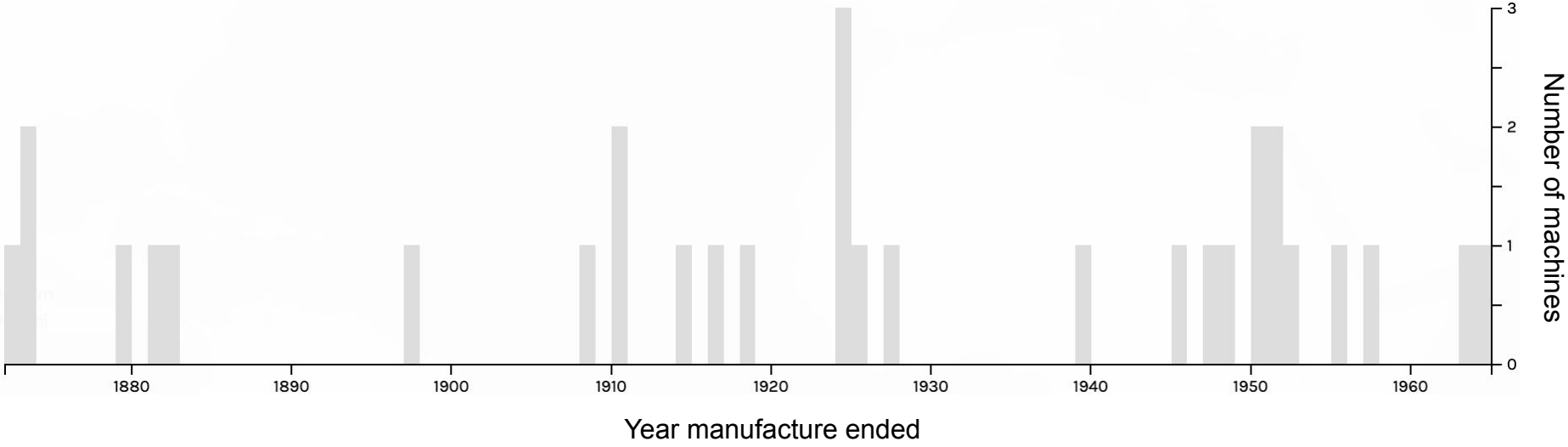
Graph showing variation of number of initial components built in tide prediction machines over time. Made by H. M. Rawsthorne using Numbers.



Map showing links between manufacture location (purple) and operation location (red) of tide prediction machines. Made by H. M. Rawsthorne using Palladio.



Timespan showing dates of manufacture (bottom) and dates of decommissioning (top) of tide prediction machines worldwide. Line gradient represents length of lifetime. Made by H. M. Rawsthorne using Palladio.



Timeline showing number of tide prediction machines that were finished being built each year worldwide. Made by H. M. Rawsthorne using Palladio.

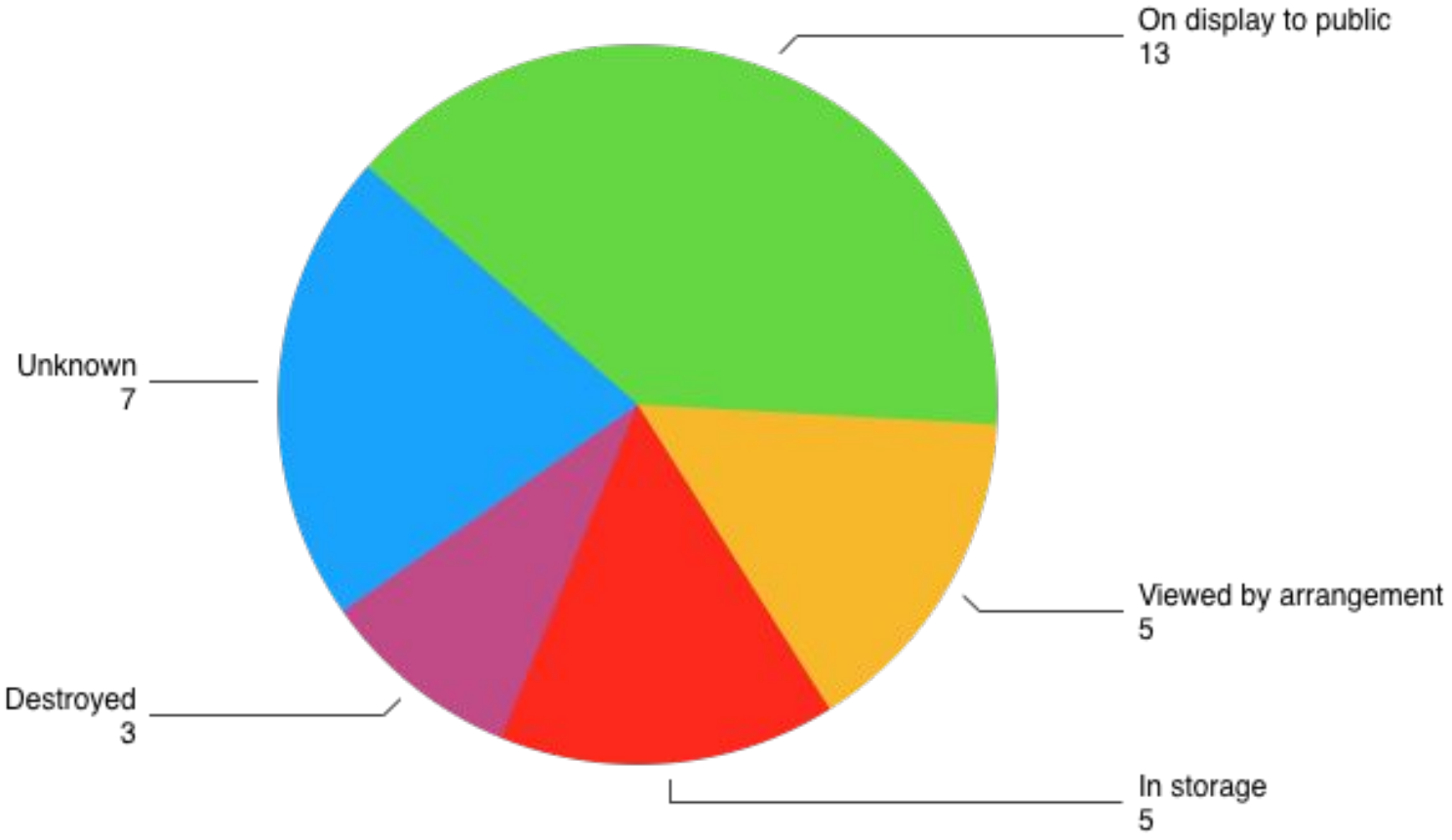
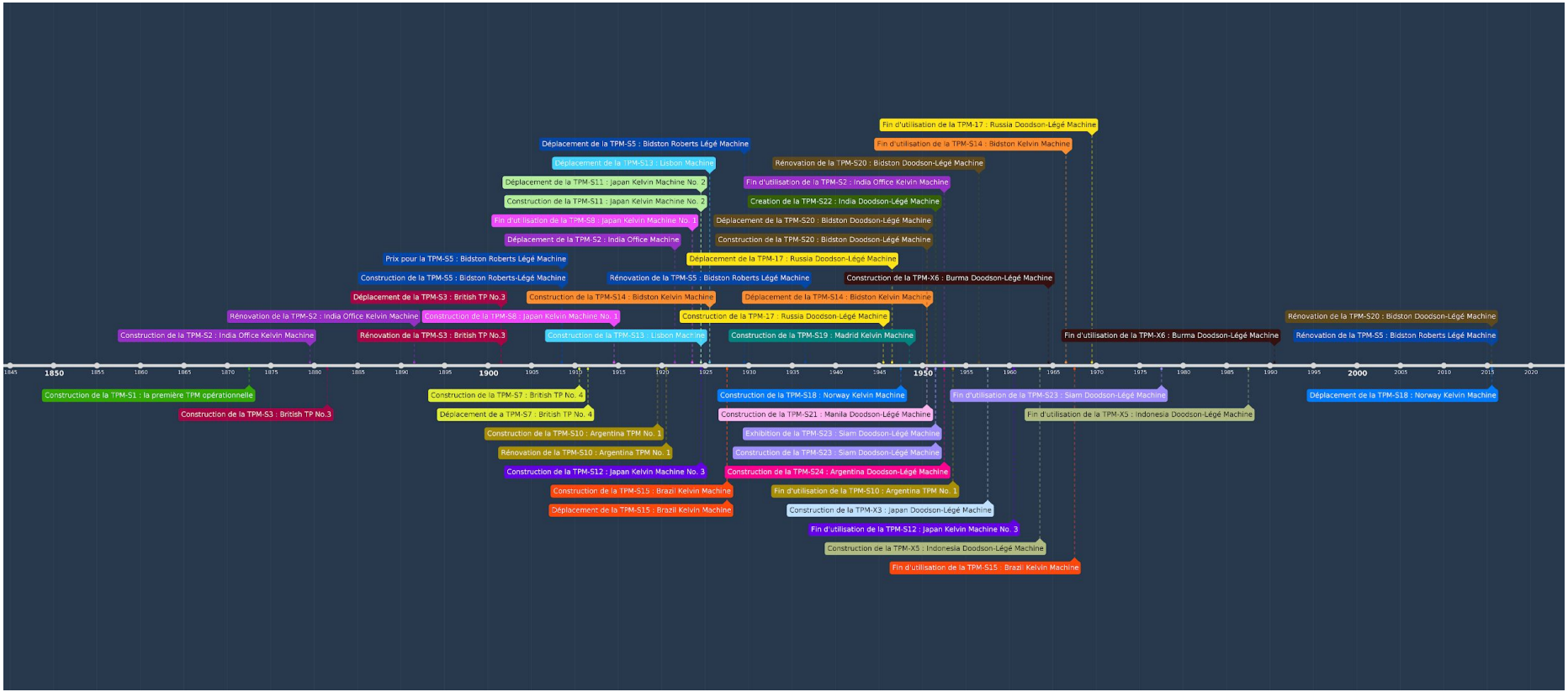


Chart showing current state of all tide prediction machines ever built. Made by H. M. Rawsthorne using Numbers.



TIMEGRAPHICS

Timeline showing life events of all tide prediction machines manufactured in Great Britain. Made by H. M. Rawsthorne using Time.Graphics.

Results and evaluation

Tide prediction machines

- Analysis of life-cycle
- How machine build changed over time
- How foreign relations impacted exportation of machines
- Science and technology: motivated by human need, shaped by the sea

Artefact prosopography

- Successful
- Larger group needed
- Need to test with different type of artefact
- Digital humanities tools essential

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