Technical Solutions for Data Systematization for Early Modern Accounting Sources
The HOLYLAB Database of Account Books of the Custody of the Holy Land

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Abstract

This article discusses the early stages of the online, open-access database of the ERC project 'HOLYLAB'. Specifically, it addresses the work done on the database sources – the account books from the Franciscan Custody of the Holy Land between the seventeenth and eighteenth centuries – and the technical solutions adopted for the purpose of data systematization. Considering such solutions in depth is crucial, we believe, for several reasons. First, these solutions make it possible to unravel the complexity and lack of structure for this type of historical data, which are both quantitative and qualitative and greatly inconsistent. They also constitute a key initial step in the analysis and design stages of a database that aims to serve different functions simultaneously: granting access to unpublished historical records, as well as allowing searches for specific objects, people, places and for changes in the circulation of money, objects, and people through space and time. Finally, doing so provides a blueprint for approaching and systematizing historical data in early modern accounting sources in a crucially flexible way, and will help other researchers who face similarly challenging and complex data when building historical databases.

Keywords: databases, data systemization, analysis and design stages, early modern history, accounting history, mobility history

L'articolo si propone di illustrare le fasi preparatorie del database, online e open-access, connesso al progetto ERC 'HOLYLAB'. In particolare, si concentra sul lavoro fatto sulle fonti per il database – i libri di conto della Custodia francescana di Terra Santa tra diciassettesimo e diciottesimo secolo – e le soluzioni tecniche adottate ai fini della sistematizzazione dei dati. Discutere tali soluzioni in profondità si rivela importante per diverse ragioni. Primo, tali soluzioni aiutano ad affrontare la complessità e mancanza di struttura che caratterizza questo tipo di dati storici, i quali hanno natura sia quantitativa che qualitativa ma profondamente disomogenea al loro interno. Costituiscono inoltre un passaggio iniziale chiave nell'analisi e progettazione di un database che punta a servire diversi scopi allo stesso tempo: garantire l'accesso a informazioni storiche inedite, così come la possibilità di effettuare ricerche su oggetti, persone e luoghi specifici e sui cambiamenti nei secoli e tra aree geografiche nella circolazione di denaro, oggetti e persone. Infine, fare ciò fornisce un modello per affrontare e sistematizzare in maniera flessibile dati storici da fonti contabili d'età moderna, e aiuterà altri ricercatori alle prese con dati storici dalle complessità e sfide simili.

Keywords: database, sistematizzazione dati, analisi e progettazione di database, storia moderna, storia della contabilità, storia della mobilità

Introduction [1]

This article gives an account of the early stages in the construction of the database for the ERC project 'HOLYLAB – A global economic organization in the early modern period: The Custody of the Holy Land through its account books (1600-1800)', based at the Università degli Studi di Roma Tre in Rome.

The database – from here onwards also referred to as HOLYLAB-DB – focuses on historical data from accounting documents produced between the seventeenth and eighteenth centuries by the commissariats of the Franciscan Custody of the Holy Land. The Custody, with its headquarters in Jerusalem, was entrusted primarily with the gathering and shipping of alms meant for the maintenance of the Christian Holy Sites in Palestine since the fourteenth century. The circulation of alms was made possible by a network of branches of the Custody placed throughout the early modern world and called commissariats. Each commissariat's head, a friar called commissary, and its secular accountant and treasurer, the apostolic syndic, kept track of

this circulation through account books; starting from the second quarter of the seventeenth century, they were also required to send extracts of these to the papal Congregation of Propaganda Fide in Rome as part of broader overseeing and sometimes auditing processes. HOLYLAB-DB is built upon such extracts, which for convenience we will call 'account books' in this article.

As an open-access online database, HOLYLAB-DB will make the data extracted from the account books of Franciscan commissariats listing their incomes and expenditures available to all researchers. The main purpose of the database is to offer free, online access to previously unpublished quantitative and qualitative information regarding the circulation of money as well as objects and people. While the website hosting HOLYLAB-DB is intended to later publish visualizations of case studies produced from the same historical datasets in dedicated sections, the database will most importantly grant access to the aforementioned information through different search functions. In this way, users will be able to perform three actions, each echoing the three target purposes of the database: access the historical record, with its data structured in chosen layers (for the 'survival' purpose); search for specific objects, people, and places (for the 'documentation' purpose); search for the circulation of money, objects, and people through space and time (for the 'variation' purpose).

Taking this into account, the aim of this article is to illustrate the processes and technical solutions adopted for the systematization of early modern accounting data by the team responsible for HOLYLAB-DB during its analysis and design stages. By doing this we hope to help researchers who are building historical databases on data that present the same challenges and complexity as ours. One way we do this is by discussing HOLYLAB-DB sources, which helps to make the connection between their presentation in the historical repository and the data systematization solutions clear. Focusing on the technical solutions for data systematization also accounts for how these were essential in being able to offer access to data in a more structured form and thus to better handle and extract the complex information stored in early modern account books.

This article will discuss the early construction stages of HOLYLAB-DB through five sections. The first section will outline the historical sources used and their features. The second section delves into the approach taken to extract and process the data for the purpose of a database, and the challenges at both the operational and entry levels that working with historical sources and data entailed in this initial stage of the work. The third section will detail the technical solutions adopted for data systematization, particularly the specific solution devised for dealing with the data regarding mobility. Following best practice for similar academic databases, technical solutions and choices that were made from the onset and those that were made in order to overcome unpredicted challenges allowed us to deal with problems as they emerged within a development feedback loop that made use of all the different expertise on the team – in digital humanities and social, economic, and religious history – as well as a continuous conversation between the digital tool and the historical documents. The fourth section will outline how the online database tool for searching HOLYLAB-DB was developed during the same initial stages, so as to keep in consideration the potential actions and searches by future users when systematizing data in the database model. The final section will reflect on the end result and will offer considerations on some important and related aspects of online academic databases, especially moving forward: the balance between complexity and detail when dealing with layered quantitative historical data, and the potential of projects like HOLYLAB-DB for the application of language models based on artificial intelligences (developed for the purpose of processing and

extracting information from texts) to even historical sources like Franciscan commissariats' account books.

1. The Sources for the Database

1.1 The Account Books of Franciscan Commissariats between the Seventeenth and Eighteenth Centuries

HOLYLAB-DB is built around historical data from account books between the seventeenth and eighteenth centuries. The main purpose of these account books was to keep track of the alms that the Franciscan order collected and shipped to Jerusalem. Since the fourteenth century the Franciscan order was entrusted by the papacy (with the agreement of the local rulers, the Mamelukes first and the Ottomans later) with maintaining the Holy Sites in and around Jerusalem so as to enable the access and devotional practices of Christians. Alms thus covered expenses for liturgical apparati of the Church of St. Sepulchre as well as for supporting the Franciscan religious community in the monastery of St. Saviour, and for food and travel by the friars travelling to and from the Levant.[2]

Indeed, Franciscan commissariats' account books do not testify only to the circulation of money or alms to and from Jerusalem and almost everywhere Franciscans were in the early modern world. Alms were moved in different forms (coin, bills of change, bequests, etc.). At the same time, the account books include money transactions relevant to the movement objects and people through the Custody's network. Moreover, objects range from everyday items meant for the sustenance of friars and pilgrims, such as food, clothes, medicines, to expensive liturgical commissions gifted by the nobility and the faithful of Europe. People (mostly friars, but also pilgrims, merchants, ship labourers, translators, etc.) travelled to carry alms and such objects to destination, or simply to join in the pilgrimages and devotional practices around the Holy Sites. This implies that the account books also record the constant flow of objects and people that accompanied the coming and going of alms from the European ports to those of Syria and Egypt up to Jerusalem.

From the information point of view this means that the data for HOLYLAB-DB are first and foremost of a quantitative nature, consisting of records of flows of money in and out, i.e., incomes and expenditures. The same data, however, comprise a wealth of qualitative information pertaining to the circulation of money, objects, and people. For example, an entry detailing the

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[2] On the Custody of the Holy Land see, among others [1]; [2]; [3]; [4], especially pp. 25-53; [5]; [6]; [7]. The origin and development of Franciscan commissariats overall are still in need of a comprehensive study, as works on commissariats have focused on specific geographical areas: [8][9]; [9]; [10]; [11]. An up-to-date survey by Umberto Cecchinato, provisionally titled 'The commissariats of the Holy Land. Origins and Development of a Franciscan Organization from the Fourteenth to the Eighteenth Century', is in the works and has been presented at an internal HOLYLAB seminar on 10th July 2023. On the commissariats' account books, see the preliminary overview in [12], while a more detailed description of them is the object of a future publication by Tramontana.

expenses incurred for shipping some alms would report their amount, but it would in the first place appear as an expenditure covering transport costs. Moreover, the same entry would potentially include information on the people travelling to transport the alms (as it was required by the Franciscan order's regulations), the transport means chosen (which ships under which country and captain), places (where anyone stemmed from and was leaving to, with possible intermediate stops along the journey), and logistics (if travellers faced quarantines or other setbacks). The same applies to incomes recording the receival of, for instance, an expensive oil lamp for the Church of the St. Sepulchre, and to the circulation of objects and people more broadly.

Data, quantitative or qualitative, also vary widely between account books and across time and space. So far, we found around 130 account books that were sent from Franciscan commissariats to Rome. The number of entries within these varies deeply: on the 'top-end' of the spectrum there are the account books from the Commissariats of Naples and Tuscany containing on average 150 entries, with that of Sicily being an outlier with an average of 300; in the middle ground, the account books of the Commissariats of Germany and Lombardy contain between, respectively, around 100 and 50 entries; and at the opposite end we have the Commissariats of Venice and Cyprus, whose account books record a dozen and fewer entries. The number of account books varies, too: the biggest contribution comes from the Commissariat of Tuscany with 47 account books, followed closely by that of Genoa with 21 and that of Lombardy with 20; for other commissariats, like Cyprus, Piedmont, Ancona, and Portugal, there is however only one each. To date, account books have returned a total of more than 9000 entries, but the number is due to increase since around 20 account books have been found in the second part of 2023. With respect to dates, the period covered by the project and its database spans two centuries starting from 1622, when the Custody was brought under the control of the papal Congregation of Propaganda Fide, as happened to regular Catholic orders that engaged in missionary activity.[3] In reality, bookkeeping was not a requirement and regulated until the middle of the century, and in practice not all Franciscan commissariats complied consistently. This, combined with the hazards of archival conservation, is reflected in the time frame covered by the account books surviving in the Congregation's archive in the Vatican City, where the earliest records date to 1651 and the latest to 1750. However, two thirds of the account books record entries from the seventeenth century. In the case of those commissariats with more or less continuous coverage (as some gaps from a couple up to twenty years occur), over three quarters of the entries from that of Genoa belong to this century, while for Tuscany and Lombardy they are evenly split. The same happens with commissariats documented by less than ten account books: while those of Naples, Sicily, and Germany cover exclusively and almost continuously the seventeenth century, those of Rome, Vienna, and Venice offer one account book each for the following century, two in the case of Malta. With respect to the commissariats providing one account book, only that of Piedmont covers the eighteenth century. A similar inconsistent coverage happens with respect to the geographical range, as Italian commissariats have the lion's share of account books sent to Rome, and non-Italian ones like Germany or Cyprus being outliers with a few account books each. What this implies for the relationship between Propaganda Fide, the Custody of the Holy Land, the Franciscan order more broadly, and the political powers of early modern Europe with respect to the management and financial

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[3] For an encompassing introduction to the Congregation, see the recent publication by [13]. Propaganda Fide issues the first organic decree on account keeping by Franciscan commissariats in 1654: Archivio Storico di Propaganda Fide (from now on ASPF), Acta, vol. 23, ff. 112r-118r, plenary meeting of 16 November 1654.

subvention of religious missions, is the subject of the on-going research work by the HOLYLAB team.

1.2 The Archival Records behind HOLYLAB-DB

Indeed, the access to and scope of the information in the account books used for HOLYLAB-DB greatly depends on their production and conservation history, therefore on the repository where they are preserved nowadays. As mentioned, all such account books were compiled for bookkeeping purposes under the requirement of the Congregation of Propaganda Fide in Rome. Thus, they are preserved in the congregation' historical archive, the Archivio Storico di Propaganda Fide, and especially in the *fondi* and series relevant to the management of missions such as the Franciscan ones. This means the account books are mostly preserved in a Miscellany volume of the section 'Terra Santa' ('Holy Land') of the *fondo* 'Scritture riferite nei congressi' (hereby SC, made of the documentation used in the restricted meetings between the Cardinal Prefect at the head of the congregation and the latter's Secretary in this case specially aimed at the territory or topic of the Holy Land). However, some can be found as correspondence attachments or simple inserts throughout other volumes of SC as well as of the *fondi* 'Scritture Originali riferite nelle Congregazioni Generali' (hereby SOCG, with the original documents used for decisions and rulings) and Acta (a long chronological *fondo* where the matters debated in the *congregazioni generali*, or plenary meetings, of the congregation were reported) when produced on specific requests, such as enquiries into fund mismanagement or changes in office – in either case in no particular chronological and geographical order.[4]

The data stored in the account books in the ASPF depend on how they are presented and recorded in the sources, as well. These mostly resemble charge and discharge account books, with incomes and expenditures listed in two consequent sections where financial transactions are recorded as single entries in a chronological order, within usually a default two-year period, and written in general by the apostolic syndic.[5] In most cases the first entry in the income section reports the existing gross funds from the previous period, and although the account books often provide partial and total balances, the charge and discharge format suggests that the main aim of the accounts was the reporting of transactions occurred during a specific time period and thus of cash flow on the short term, not of any capital funds or profit.[6] More importantly, in each entry all information recorded revolves around the financial transaction, be it income or expenditure, making all additional qualitative but also quantitative data, such as exchange rates or the number of acquired items, accessory to the flow of money in and out of the account books.

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[4] On the ASPF and the archival series mentioned here, see [14], [15], and [16].

[5] Some early account books from the Commissariat of Genoa are, in fact, built around dates, with incomes and expenditures listed together to follow the chronological order, or even a double-entry system. Moreover, account books created outside of regular account keeping by commissariats, such as on the occasion of enquiries into fund management can cover more years: see the case of the 'Conti del Commissario di Terra Santa in Lombardia dal 1742 al 1750' in ASPF, SC, Terra Santa, vol. 10, ff. 39-40. For an introductory overview of early modern accounting documents see [17].

[6] See the observations by [17], 6-7, in this sense.

All this resulted in collections of both quantitative and qualitative data that served different purposes at the same time, while presenting themselves as firstly and mostly for accounting ones. In other words, the sources include a wealth of quantitative and qualitative information all nested in the 'event zero' that is the financial transaction or entry, i.e. the single income or expenditure. On the one hand, the datasets are therefore essentially open to the presence of overlaps, gaps, and additional less relevant information, potentially complicating their access and use.[7] On the other hand, the structure and features of the account books form a supposedly faithful record of all the movements of money at a particular place in time and space. Moreover, the additional information about the movement of objects and people (and all that went with this, such as dates and origins of travellers) turns the account books into useful sources for the management and control of everything that was travelling through the Custody's network, by providing extra, complementary information to that recorded in sources like the registers of travelling friars.[8]

2. Working on Early Modern Account Books Data

2.1 Key Principles During the Implementation & Testing Stage

As a result, in building a database that would allow us to access and use this type of historical quantitative and qualitative data, we believed that HOLYLAB-DB had to achieve that by respecting the structure and features of its sources. In other words, in the database model all information about the circulation of money, objects, and people was going to be kept nested in the financial transaction, to highlight the main purpose of the entries, but also structured in sections corresponding to the mentioned layers of information, so as to shed light on the additional functions that the account books served, for instance recording the friars travelling with the alms. In this sense, the choice of structuring each entry around the financial transaction enabled us to remain faithful to how the account books of Franciscan commissariats are arranged, while also showing how the financial transaction works as an 'event zero' or catalyst for all additional information. This approach also meant we would be able to later tailor different search functions of the database search tool to its three intended main purposes while keeping the relationship between all the layers visible. In this way information on the names and numbers of travelling friars always link back to the cost of their journey, when paid for by a commissariat, i.e. the original expenditure for the journey in question.

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[7] For a case of overlapping account books see the three account books from the Commissariat of Sicily which cover, respectively, from December 1658 to November 1660 and August 1659 to November 1660, all with different entries recorded: ASPF, SC, Terra Santa, Miscellanea 1, 'Conti di Terra Santa del anni 1659 e 1660 della Commissione del Regno di Sicilia per mandarli alla Sacra Congregatione de Propaganda Fide', unnumbered pages, and Ibidem, 'Conti di Terra Santa mandati dal Padre Carbascial Commissario Generale di Sicilia', unnumbered pages. A few straightforward duplicates survive, too, as in the case of two matching account books for the Commissariat of Genoa for the period from December 1677 to December 1678: ASPF, SC, Terra Santa, Miscellanea 1, 'Genova 28 dicembre 1678' and 'Conti dalli 28 dicembre 1677 sino alli 28 dicembre 1678', both with unnumbered pages.

[8] See, for instance, the three volumes of 'Passaggi di religiosi' for 1700-1770 recording friars travelling through the Commissariat of Tuscany: Florence, Archivio Storico della Provincia Toscana dei Frati Minori, Provincia di San Bonaventura, Archivi Aggregati, Commissariato di Terra Santa di Livorno.

To do that, some of the sources and information within them worked better than others. The rationale of the project is to investigate how financial tools like account books were used in the newly established relationship between the Franciscan order and the Congregation of Propaganda Fide. Therefore, with respect to sources HOLYLAB-DB is built on data from the account books of Franciscan commissariats preserved in the ASPF. Nevertheless we kept account books found here that cover similar or the same year periods, as overlapping sources usually offer additional, if not entirely different information for the same period.[9] We chose not to include account books preserved in other repositories or institutions part of the Custody's network to fill in gaps in year periods, like the account books of the Commissariat of Tuscany dating from 1661 onwards in the Archivio Storico della Provincia di San Francesco Stimmatizzato in Florence, to concentrate on the sources produced for and sent to Propaganda Fide. From the point of view of the information inside the account books, we decided not to include the financial data pertaining to partial and total balances and yearly summaries of incomes and expenditures, as such data are not useful to the purpose of the project, but they are still made available to users of HOLYLAB-DB as they were transcribed in the Notes section of the opening and final entry of the relevant account book. Gross funds from previous accounting periods were however considered like incomes, even when they are equivalent to previous total balances, as they belong to the flow of money in and out of each commissariats' account, similarly to deposits and transfers from other commissariats.

2.2 The Analysis and Design Stage

The first specific challenges we faced pertained to the aggregation, uniformity, and significance of our data. In light of what discussed above, the data was clearly unstructured and not consistent from the statistical point of view. Unstructured because quantitative and qualitative information (such as the number of travellers of a particular journey) had to be extracted from the discursive part of the entry – and in some cases also from a comparison between different entries and account books.[10] Data were also inconsistent firstly because, as said, the surviving account books do not cover the same two-year periods for all commissariats and they present gaps in accounting periods within the same areas, too. Secondly, different units of measurement and languages were used in the entries. While language variety only posed a limited obstacle when trying to identify the people and places reported in the entries, with respect to money it was undeniably problematic that the account books used different early modern currencies, without conversion rates from Propaganda Fide for in-between currencies and with other financial tools like bills of change. For instance, while some account books employed the local currency, such as ducats in Malta or florins in the German-speaking lands, the majority of them uses money of account. On top of that, other quantitative data were permeated with problems, too: measurements of weight and length were not consistent, the number of items paid for or received was often not recorded, and expenditures and incomes were regularly not itemized, making it impossible to recover the price of the single objects, or types of them, listed in the entry. The solution for the first problem came from data atomization, as we explain next, while the latter two aspects are touched upon in paragraph 5.2.

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[9] See the case of the account books from the Commissariat of Sicily mentioned in n. 7.

[10] See the case of the friar Ludovico da Pontuasa illustrated by [18], where data from Franciscan commissariats' account books are used for the first time, albeit not for quantitative analysis.

To systematize data from different geographical and temporal contexts and make them comparable and searchable, the first step was to structure them as thoroughly as possible. Through an overview and sampling of early transcriptions of a selected group of account books we created a database model in Excel with 44 variables nested in 5 layers (plus Notes): the Archival Record (the light gray section in Figure 1, with the Transcription in full body gray), the Financial Transaction (green section), Object Circulation (blue section), People Circulation (red section), and Journeys (yellow section). Such detailed structure allows us to break information into consistent, unique, and self-contained variables, in a process referred to as data atomization, when it was necessary to offer a finer level of detail. For instance, this allowed us to split the information about units of measurement into two separate variables, one for the quantity and another for the unit of measurement, in order to make different analyses possible, on one or both of these variables, in combination with others or not, as well as to account for most possible record scenarios: different units of measurement employed within the same source and across account books, different languages and spellings for the same unit of measurement, no quantities recorded, to name a few. Furthermore, the structure accounts for the possibility of comparable datasets to be added to the database in the future, for instance from the account books of the monastery of St. Saviour in Jerusalem or other repositories for the commissariats already entered, potentially only differing thus in the Archival Record section. Specifically, we kept the variable "BHC = Holdings – City" even if at the current state "BHA = Holdings – Authority" is enough because all records entered into HOLYLAB-DB come from the ASPF.

ID	Variable Code	Variable	Value
HL1	A	Transcription	
HL1	BRRFS	Record - Repository, fondo, and series	
HL1	BRUD	Record - Unit and document	
HL1	BRD	Record - Date - dd/mm/yyyy	
HL1	BHA	Holdings - Authority	
HL1	BHC	Holdings - City	
HL1	BED	Entry Date - dd/mm/yyyy	
HL1	CTTIE	Transaction - Income/Expenditure	
HL1	CTTC	Transaction - Category	
HL1	CTTO	Transaction - Object	
HL1	CRVQ	Recorded Value - Quantity	
HL1	CRVC	Recorded Value - Currency	
HL1	COC	Original Currency	
HL1	CTS	Transaction - State	
HL1	CTC	Transaction - Commissariat	
HL1	CAGP	Alms - Gathering Period	
HL1	CTEP	Transaction - Expenditure Period	
HL1	CTHW	Through Whom	
HL1	CTW	To whom	
HL1	CFW	For Whom	
HL1	CBW	By Whom	
HL1	D	Object Circulation Data	
HL1	DOQ	Objects - Quantity	
HL1	DOU	Objects - Unit	
HL1	DOT	Objects - Type of Object	
HL1	DOD	Objects - Object Description	
HL1	E	People Circulation Data	
HL1	EQ	Quarantine - If	
HL1	EQD	Quarantine - Duration	
HL1	EQW	Quarantine - Where	
HL1	FP	Place A	
HL1	FS	Stage A	
HL1	FSP	Specification of Place A	
HL1	FOD	Object Description at Place A	
HL1	FNTP	Name of Travellers at Place A	
HL1	FQTP	Quantity of Travellers at Place A	
HL1	FL	Leg a	
HL1	FMT	Means of Transport a	
HL1	FTT	Type of Transport a	
HL1	FSDL	Starting Date for Leg a - dd/mm/yyyy	
HL1	FEDL	End Date for Leg a - dd/mm/yyyy	
HL1	FLQ	Legs - Quantity	
HL1	FLP	Legs - Paid	
HL1	NOTES	Notes	

Figure 1. Core structure of a single entry/transaction in the database.

When moving on to deal with inconsistency, we adopted tailored solutions. For currencies and units of measurement (weight, length, etc.), conversion tables will be later published in a dedicated section of the HOLYLAB-DB website once all the relevant data will be extracted and analyzed. The tables will offer links to equivalences over time for each unit to allow scholars interested in this aspect to draw calculations and comparisons. In the case of languages, a balance was achieved between preserving the original text with its historical and geographical variants and allowing a degree of uniformity to the database, which is built in English for an audience of international users. The researchers doing data entry were instructed to adhere to the archival

documentation by keeping the original language in most specific variables (names and descriptions of items), but where possible professional and honorary titles, currencies, and places were translated into English, with the possibility of checking for typos through group discussions during data entry and vocabularies in list menus (on which see later below). Atomizing data became useful also in the case of languages, as creating two separate variables for certain information allowed entering values first in English then in the original text to add a further layer of description. For instance, in the Object section the "DOT = Objects – Type of Object" is first recorded in English, and the following "DOD = Objects – Object Description" consists of a direct quotation from the financial transaction.

3. Technical Solutions for Data Systematization

The technical solutions adopted for the purpose of systematizing and structuring the information extracted from the account books were dictated by both the characteristics of such data and the need to create a comfortable and intuitive tool for the researchers doing data entry. The data collection and entry phase, in fact, was carried out during the transcription of the documents and the preliminary organization of the transcripts and had to remain open to process additional, diverse account books due to the nature of archival research.

On the one hand, indeed, the optimal tool had to allow the database structure to be updated easily, because of the occurrence of particularly complex cases among the transactions analyzed during the data entry stage and the inconsistency of content and therefore variables across account books. Moreover, it had to allow the person doing data entry to autonomously replicate certain variables when necessary (for example, in the case of transactions associated with the circulation of objects of different types and quantities). On the other hand, the ideal solution must guarantee ease of use and the limitation, as far as possible, of typographical errors.[11]

3.1 Description of the Technical Solutions Adopted for Data Entry

For the reasons just mentioned, the technical solution to structure the transactions in the database was designed and implemented as follows:

- The data entry template was created using a Microsoft Excel spreadsheet, as this application is available in a common Office suite and easy to use and access remotely by all researchers doing data entry, thus representing a more efficient investment in terms of money and training time compared to more structured database tools like Microsoft Access or MySQL.
- A single spreadsheet is designed to contain up to 500 transactions or entries, rounding the default minimum number of entries upwards based on the account books initially sampled. The technician responsible for uploading the data to the online database tool, hosted on a platform provided by the Roma Tre University and working with the MariaDB RDBMS (see on this paragraph 4.1), is therefore entrusted with the task of integrating the various sources into a single database.

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[11] See [19], for the suggestion of a database model meant to overcome the rigidity in this sense of most commonly-used RDBMS.

- Within the database, each transaction is represented by a series of variables, according to the scheme shown in Figure 1. The type of variables is pre-set (there are 44 types of variables, each associated with a unique *Variable Code*), while the number of variables may vary according to the characteristics of the transaction.

- As visible in Figure 1, the template was created in *long* or *narrow* format, with the aim of allowing the researchers doing data entry to expand the number of variables for the single entry at will, replicating those required by the specificity of the transaction. The advantage of the long format, in this sense, is that the addition of new variables for an entry involves an expansion of that entry only, unlike the wide format, in which the addition of a new variable for a single transaction would require inserting a new column in the table (which would therefore quickly become unmanageable and always display additional variables that might not apply to all entries).

- Some types of variables include a 'Data Validation' mechanism, which binds the input entered by researchers to compliance with certain conditions (in this specific case, belonging to a set, or vocabulary, of pre-set options) and which therefore allows to reduce the number of typos during data entry. The mechanism was conceived for Boolean variables (such as "D = Object Circulation Data", "E = People Circulation Data", and "EQ = Quarantine – If") and for variables for which it was possible to preliminarily establish sets of values able to cover almost all the cases (such as "CTTIE = Transaction – Income/Expenditure", "CTTC = Transaction – Category", "CTTO = Transaction – Object", "DOT = Objects – Type of Object", and "FMT = Means of Transport a"). For the latter group of variables, however, there is the possibility of expanding the set of values with the progress of data entry. To apply the validation mechanism to the spreadsheet, a 'macro' written in the Visual Basic for Applications (VBA) programming language was used. This solution will also allow future users to tailor searches in the database by including or excluding entries which report circulation of people, objects (or both), as well as to display the relevant section in the entries' page only when such information is present.

As regards the core structure of the single entry, made up of 44 types of variables, it is appropriate to dwell on the choices made for the variables referred to the places crossed by goods and people (the yellow section in Figure 1), as they clarify the flexibility of this scheme with respect to particularly complex transactions.

If we consider, for example, the following transaction:

> *Per due frati che vennero di Siracusa mandati dal padre Commissario di Napoli con 8mila piastre ed altre provisioni et anco altre due che vennero apresso di Missina e se ne partirono per Acri, spesero 6 11 6,[12]*

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[12] "For two friars who came from Syracuse sent by the Commissary of Naples with eight thousand piastre and other provisions and two others who came from Messina and left for Acre, they spent 6 [scudi] 11 [tarì] 6 [grani]": account book for the years 1655-1659 'Conti dati da fra Michele da Malta Commissario di Terra Santa tenuti dal Dottor Giuseppe Casciar Sindico', ASPF, SC, Terra Santa, Miscellanea 1, ff. 1-5 plus unnumbered pages.

which describes the travel of four friars and the circulation of goods associated with their movement, the advantages of the scheme shown in Figure 1 are immediately evident.

The movements of goods and people in question are summarized in the flow chart in Figure 2.
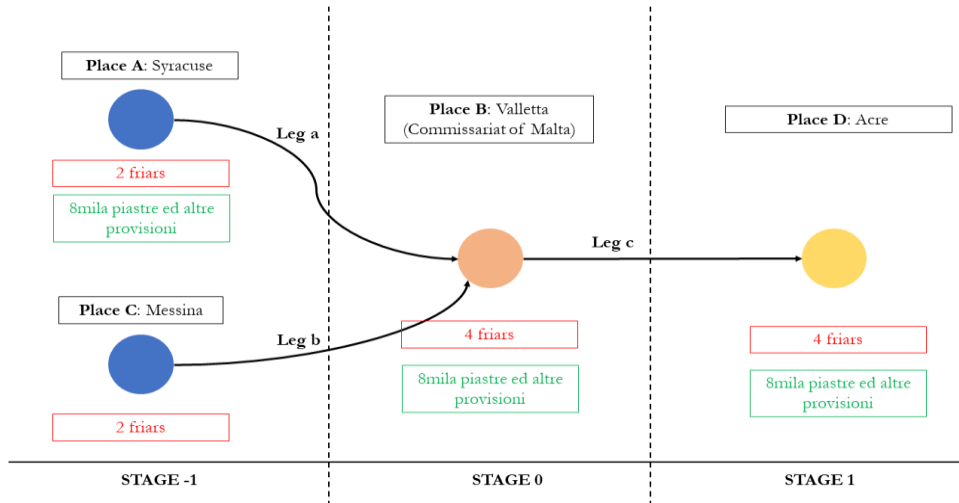

Figure 2. Schematic representation of the movement of goods and people associated with the considered transaction.

According to this diagram, it is possible to identify different 'stages' of the journey with respect to the passage through the commissariat where the transaction is registered. This passage is therefore associated with stage 0, while the previously crossed places have negative values for this variable, and the subsequently crossed ones have positive values. As shown in Figure 2, it is possible that several places share the same 'stage', as they are transit points for different groups of travelers or goods. Figure 3 shows an example of how the flow chart representation (Figure 2) is structured in the database scheme. For each place, six variables are defined, on the model of place "A" in Figure 3, while for each leg of the journey five variables are defined, on the model of leg "c". In the end, two general variables ("FLQ = Legs – Quantity" and "FLP = Legs – Paid") report, respectively, the total amount of legs and the possibility that the transaction covered the travel expenses of some, or even none, of these legs.

Place A	Syracuse
Stage A	-1
Specification of Place A	n/d
Object Description at Place A	8mila piastre ed altre provisioni
Name of Travellers at Place A	n/d
Quantity of Travellers at Place A	2

Leg c	B-D
Means of Transport c	ship
Type of Transport c	n/d
Starting Date for Leg c - dd/mm/yyyy	n/d
End Date for Leg c - dd/mm/yyyy	n/d

Legs - Quantity	3
Legs - Paid	n/d

Figure 3. Visualization (for the considered transaction) of the base structure of places and legs, described by six and five variables respectively in the current database scheme.

ID	Variable Code	Variable	Value
HL45Ma	A	Transcription	Per due frati che vennero di Siracusa mandati dal padre Commissario di Napoli con 8mila piastre ed altre provisioni et anco altre due che vennero apresso di Missina e se ne partirono per Acri, spesero 6 11 6
HL45Ma	BRRFS	Record - Repository, fondo, and series	SC, TS, Miscellanea 1
HL45Ma	BRUD	Record - Unit and document	Conti dati da fra Michele da Malta Commissario di Terra Santa tenuti dal Dottor Giuseppe Casciar Sindico, ff. 1-5 + n.n.
HL45Ma	BRD	Record - Date - dd/mm/yyyy	11/05/1659
HL45Ma	BHA	Holdings - Authority	CPF
HL45Ma	BHC	Holdings - City	Rome
HL45Ma	BED	Entry Date - dd/mm/yyyy	n/d
HL45Ma	CTTIE	Transaction - Income/Expenditure	expenditure
HL45Ma	CTTC	Transaction - Category	expenditure
HL45Ma	CTTO	Transaction - Object	expenditure
HL45Ma	CRVQ	Recorded Value - Quantity	06;11;06
HL45Ma	CRVC	Recorded Value - Currency	Maltese scudo
HL45Ma	COC	Original Currency	n/d
HL45Ma	CTS	Transaction - State	Malta
HL45Ma	CTC	Transaction - Commissariat	Commissariat of Malta
HL45Ma	CAGP	Alms - Gathering Period	n/d
HL45Ma	CTEP	Transaction - Expenditure Period	11/05/1657-11/05/1659
HL45Ma	CTHW	Through Whom	n/a
HL45Ma	CTW	To whom	n/a
HL45Ma	CFW	For Whom	four friars
HL45Ma	CBW	By Whom	n/a
HL45Ma	D	Object Circulation Data	yes
HL45Ma	DOQ	Objects - Quantity 1	8000;00;00
HL45Ma	DOU	Objects - Unit 1	piastre
HL45Ma	DOT	Objects - Type of Object 1	money
HL45Ma	DOQ	Objects - Quantity 2	n/d
HL45Ma	DOU	Objects - Unit 2	n/d
HL45Ma	DOT	Objects - Type of Object 2	provisions
HL45Ma	DOD	Objects - Object Description	8mila piastre ed altre provisioni
HL45Ma	E	People Circulation Data	yes
HL45Ma	EQ	Quarantine - If	n/d
HL45Ma	EQD	Quarantine - Duration	n/d
HL45Ma	EQW	Quarantine - Where	n/d
HL45Ma	FP	Place A	Syracuse
HL45Ma	FS	Stage A	-1
HL45Ma	FSP	Specification of Place A	n/d
HL45Ma	FOD	Object Description at Place A	8mila piastre ed altre provisioni
HL45Ma	FNTP	Name of Travellers at Place A	n/d
HL45Ma	FQTP	Quantity of Travellers at Place A	2
HL45Ma	FP	Place B	Valletta
HL45Ma	FS	Stage B	0
HL45Ma	FSP	Specification of Place B	Commissariat of Malta
HL45Ma	FOD	Object Description at Place B	8mila piastre ed altre provisioni
HL45Ma	FNTP	Name of Travellers at Place B	n/d
HL45Ma	FQTP	Quantity of Travellers at Place B	4
HL45Ma	FP	Place C	Messina
HL45Ma	FS	Stage C	-1
HL45Ma	FSP	Specification of Place C	n/d
HL45Ma	FOD	Object Description at Place C	n/a
HL45Ma	FNTP	Name of Travellers at Place C	n/d
HL45Ma	FQTP	Quantity of Travellers at Place C	2
HL45Ma	FP	Place D	Acre
HL45Ma	FS	Stage D	1
HL45Ma	FSP	Specification of Place D	n/d
HL45Ma	FOD	Object Description at Place D	8mila piastre ed altre provisioni
HL45Ma	FNTP	Name of Travellers at Place D	n/d
HL45Ma	FQTP	Quantity of Travellers at Place D	4
HL45Ma	FL	Leg a	A-B
HL45Ma	FMT	Means of Transport a	ship
HL45Ma	FTT	Type of Transport a	n/d
HL45Ma	FSDL	Starting Date for Leg a - dd/mm/yyyy	n/d
HL45Ma	FEDL	End Date for Leg a - dd/mm/yyyy	n/d
HL45Ma	FL	Leg b	C-B
HL45Ma	FMT	Means of Transport b	ship
HL45Ma	FTT	Type of Transport b	n/d
HL45Ma	FSDL	Starting Date for Leg b - dd/mm/yyyy	n/d
HL45Ma	FEDL	End Date for Leg b - dd/mm/yyyy	n/d
HL45Ma	FL	Leg c	B-D
HL45Ma	FMT	Means of Transport c	ship
HL45Ma	FTT	Type of Transport c	n/d
HL45Ma	FSDL	Starting Date for Leg c - dd/mm/yyyy	n/d
HL45Ma	FEDL	End Date for Leg c - dd/mm/yyyy	n/d
HL45Ma	FLQ	Legs - Quantity	3
HL45Ma	FLP	Legs - Paid	n/d
HL45Ma	NOTES	Notes	friars from Syracuse sent by the Commissary of Naples

Figure 4. An example of the data entry for the financial transaction quoted in this section (see n. 12).

3.2. Updates to the Database Structure

The first phases of data entry went hand in hand with an update of the database structure, to make it more suitable for effectively representing the increasingly complex transactions that gradually appeared, up to the final version shown in Figure 1. The update of the template – and the transfer of the entered data from one version to another – was managed with a Python script (version 3.7.4), using the Pandas library, after a brief data cleaning step, and again resorting to the VBA language for the application of the 'Data Validation' mechanism.[13]

In this way, the database structure devised for HOLYLAB-DB remains simple and adaptable as well as user-friendly towards any early-modern researcher involved in the data entry. Data atomization and systemization work in the same direction but also strengthen the potential interoperability of the database. This includes collaborations between HOLYLAB and other database projects, but above all in the prospect of dataset additions, such as from account books preserved in further repositories and institutions within the Custody's network. Its biggest advantage, however, is its adaptability to potentially new historiographical findings on the sources feeding the database. For instance, the choice of implementing pre-established sets of values for certain variables alongside the possibility of expanding them as data entry progresses provided the necessary flexibility when dealing *simultaneously* with early modern accounting and mobility data, something that has few precedents within academic database projects.[14]

4. Designing the Online Database

4.1 Tools and Platform

The described solutions for the database structure were also adopted with the design and feeding of the online database in mind. Keeping the data entry tool simple and adaptable will allow the technician responsible for uploading the data to do so effortlessly at any point. More importantly, however, it also enables any HOLYLAB team member to transform and process data for the purpose of data analysis directly from the spreadsheets and while data entry is progressing. Moreover, the customized systemization and structuring of account books data allowed by the adaptable data entry template will inform the online query tool and the single-entry display.

Indeed, among the objectives of the ERC HOLYLAB project there is the dissemination of data extracted from Franciscan commissariats' account books, and structured according to the previously exposed scheme, through an online, open-access database. This will use the hosting service made available by the Roma Tre University for national and international research

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[13] Pandas - Python Data Analysis Library: https://pandas.pydata.org/ (last visited, October 13, 2023).

[14] Despite differences due to the sources used, which mean HOLYLAB-DB has for instance a wider timeframe, a similar combination of early modern economic sources and visualizations on the circulation of both people and goods is offered by the database of the French National Research Agency project 'PORTIC – PORTs & Information and Communication Sciences and Technology. Querying and visualizing eighteenth-century shipping and trade dynamics in the digital era', https://anr.portic.fr/ (last visited, October 13, 2023). See n. 16 for another database project that was of great inspiration for HOLYLAB-DB.

projects, which is integrated with Wordpress, already in use for the project's website, and comes equipped with the MariaDB RDBMS for query building purposes.[15]

By being hosted on a Wordpress platform, licensed to a public, state university like Roma Tre, HOLYLAB-DB complies to the criteria of being open access in two ways: first it stores its raw data in the open-access repository of the host university, IRIS, secondly it maximizes accessibility, reusability, and further ensures the secure storage of its data by using open-source platforms for the website and online database tool.

4.2 The User's Experience

Following the example of solutions designed and implemented for similar problems, the online database will be searchable with generic or specific queries for single variables and associated with static and dynamic visualizations (cartographic, or by means of graphs or Sankey diagrams) of the circulation of goods and people.[16] JavaScript applications (based on the jQuery library and on AJAX – 'Asynchronous JavaScript and XML', for the creation of 'asynchronous' content) are involved in the database query and dynamic visualizations of the results. Furthermore, downstream of the data entry process, and following a work of standardization and identification of the names of places and people (often reported in a different way from transaction to transaction), the database user will be able to search for transactions related to specific individuals or locations.

As regards the SQL queries that could be made by the user, given the relational structure of the database and considering the types of variables, queries based alternatively on values or ranges of values (e.g. in the case of numeric or date variables), on options from prefixed lists (for Boolean variables and for constrained ones, which we discussed above), or on matching with a specific string (for variables of type string) are set up to be included online.

The introduction of accessory relations/tables in the database, for example representing the places described in the transactions with respect to the corresponding geographical coordinates, also opens the possibility to allow in the future the creation of cartographic visualizations of the routes followed by groups of people and/or goods. Finally, the very relational nature of HOLYLAB-DB makes it possible to integrate it through permalinks with other online databases and thus with larger, more complex datasets at any point in the future.

5. Concluding Reflections

5.1 Database Possible Applications and Outlook

The structuring of data from early modern account books and their dissemination via an online database as in HOLYLAB-DB offers plentiful opportunities and suggestions to scholars beyond the immediately visible. The greatest potential comes from the growing development of language

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[15] HOLYLAB webpage: https://holylab-erc.uniroma3.it/ (last visited, October 13, 2023).

[16] We are particularly indebted to the ERC project 'AveTransRisk – Average-Transaction Costs and Risk Management during the First Globalization (Sixteenth-Eighteenth Centuries)': https://humanities-research.exeter.ac.uk/avetransrisk/ (last visited, October 13, 2023). For an introduction to the project, see [20] and [21].

models based on artificial intelligences (mainly referred to as Natural Language Processing – 'NLP' – techniques) able to process and extract information from increasingly long textual sequences.[17] In this sense the insertion of a transaction in the database after a preliminary data systematization can be thought of as a form of *labeling* or annotation (by means of the 44 types of variables) of the transcript relating to the transaction itself. Therefore, by relying, at the end of the data entry phase, on thousands of carefully labeled transcriptions, a possible application of HOLYLAB-DB would be to adapt NLP techniques to the language of these texts, and to create solutions capable of autonomously extracting the information of interest from other transcriptions.

5.2 The Purpose of Data Systemization – and Ongoing Challenges

At the current stage of development HOLYLAB-DB still answers to the most pressing of needs behind the project and the choice of a database, that is, offering access to datasets from early modern account books in a more structured form that will help make sense and use of the complex information therein. Indeed, the project's goal was to grant access to a distinctive type of historical sources as well as to the data in these, in other words to create an effective and accessible research tool for users interested in information on early modern prices, currency, mobility, and connected topics. Focusing on data systemization before and during the data entry stage allowed us to both overcome initial challenges, such as how unstructured our historical data were, and create different layers of information that consider the possibility to tailor searches by future users.

Specific challenges are still present, mostly due to how expenditures and incomes were recorded in the sources. An on-going one is how most financial transactions involving more objects or people are not itemized, that is, they are recorded as lump sums, without any specification of single costs or prices. In the very few cases this happens, the single amounts of money were transcribed in the Notes section.[18] However, lacking this type of information for most expenditures and incomes hinders a more detailed analysis of the value of goods and services, in their variations across the areas and years considered by the surviving account books, but also in the perspective of comparing money and trade practices exercised by the Franciscan order to those of the contemporary early modern world.

Despite challenges like this, we decided that the model for HOLYLAB-DB as described here provided best for its intended uses, and especially the three main purposes around which a database fitting the HOLYLAB project was conceived. First, by keeping the financial transaction as the 'event zero' and catalyst of the database, HOLYLAB-DB produces a faithful image of Franciscan commissariats' account books, thus serving the 'survival' purpose of accessing the historical record in its complexity. At the same time, the database is able to use the same transactions to unearth which objects, people, and places were part of the everyday experience

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[17] [22]; [23].

[18] As in the case of the entry recorded on 6 September 1698 from the account book of the Commissariat of Venice for the years 1694-1698: ASPF, SC, Terra Santa, Miscellanea 1, 'Conti di Terra Santa ovvero Gerusalemme', unnumbered pages: "Spese di proviggioni mandate in Gerusalem come appare dalle ricepute in manno del signore Sindico Apostolico, e sono per la prima condotta lire 6736, soldi 8; seconda condotta lire 3522, soldi 6; terza condotta lire 4345, soldi 10; totale lire 14604, soldi 4".

of alms giving within the Custody network, for the 'documentation' purpose, and to determine their movements and the variations of these across space and time, serving the 'variation' purpose. Consequently, we believe that the processes and technical solutions adopted for HOLYLAB-DB provide a blueprint for approaching and systematizing historical data in early modern accounting sources in a vitally important flexible way. By illustrating the decisions taken during such early analysis and design stages, we hope this article will help other researchers who face similarly challenging and complex data when building historical databases.

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