Use of Social Network Analysis to Explore the People of Medieval Scotland

by Cornell Jackson and Matthew Hammond

Citation


Abstract

This paper describes exploratory research to see what social network analysis can reveal about medieval Scottish society that traditional historical methods cannot. The overall goal is to understand the process of how the nation of Scotland came into being. After describing the People of Medieval Scotland database, the paper gives an introduction to social network analysis and how it has been used in history by other researchers. The research takes two tracks. First, it used a network of charter witnesses to reveal that Duncan II, Earl of Fife, was extraordinarily well connected in medieval Scottish society to an extent not known before. Second, using a network density model, it was possible to identify new opinion leaders who would have helped in spreading the concept of a unified Scottish kingdom through use of the Scottish Regnal Sicut clause in their charters.
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1. Introduction

The Leverhulme Trust-funded project, ‘The Transformation of Gaelic Scotland in the Twelfth and Thirteenth Centuries’, addresses questions of social change ‘from within’ a medieval society. The Scottish kingdom experienced ‘Europeanization’ by invitation in a process which saw the development of the recognisable unified realm with institutions like Common Law, Sheriffdoms, and Burghs. The result was a nation that was politically independent but culturally and linguistically more similar to other northern European countries. The goal of the project has been to better understand this process through the combination of digital prosopography and social network analysis.

2. The People of Medieval Scotland Database

The core of the People of Medieval Scotland (PoMS) database was completed in 2010, covering the period 1093 to 1286, which was subsequently extended to 1314. The research discussed in this paper is restricted to the pre-1286 core (Beam et al., 2012). PoMS is structured according to the ‘factoid model of prosopography’ developed by John Bradley at the Department of Digital Humanities at Kings College London and previously used on the Prosopography of Anglo-Saxon England (PASE) database. PoMS employs a relatively simple factoid structure with transactions, possessions, titles and occupations, and relationships; the only four factoid types used. Statements about people appearing in the documents are made by linking Person and Document entities through the factoids (Bradley and Pasin, 2013). Relationship factoids represent explicit statements about human connections made in the historical documents. There are 191 relationship types falling into three categories: family, employment, and landholding. We have graphed these relationships using Gephi and have analysed them according to the Social Network Analysis (SNA) concept of betweenness centrality which measures how often a person serves as a go between in the
network. A general overview of social network analysis is below. In this paper however, we are attempting to use SNA to shed light on the implicit relationships found mainly in the transaction factoids.

Since it was built using only charters and similar administrative documents, there is a relatively standard format to the source material which was reflected in the database’s design. The pre-1286 core comprises 15,221 persons and institutions drawn from 6,014 documents (Hammond 2013, 7). These persons and institutions ‘interact’ primarily through the transaction factoids, of which there are 14,112. These transactions represent actual moments of social interaction: documents reflecting multiple social ‘moments’ will also have multiple transactions. Persons are assigned a ‘role’ in the transaction which represents their social function. The most common transaction type was the gift (24% of all transactions). All gifts will have a grantor and a beneficiary and they are typically joined by witnesses, whose duty was to remember and be able to bear witness to the property transfer (Hammond 2013, 13). Traditional historical methods have long incorporated discussion of witnesses and they are typically a key part of medieval prosopography. These methods are very limited however, in terms of considering witnesses in aggregate, or in identifying patterns in large-scale groups of witnesses across multiple transactions. We have focussed our SNA research on co-witnessing patterns among persons in the PoMS database.

3. Defining Social Networks and Why They are Important

Social networks are defined and measured as connections among people, organisations, political entities (states and nations) and/or other units. Social network analysis is a theoretical perspective and a set of techniques used to understand these relationships (Valente 2010, pg. 3). Christakis and Fowler (2010, pg. 32) say that the science of social networks provides a distinct way of seeing the world because it is about individuals and groups and how the former becomes the latter.

Social network analysts view society through a structural lens. The structural view says that the structure of society and the relationships that form these societies are as important as the attributes of individuals in explaining what happens in society. Why is the structural view of society so important? Why are the relationships that form social networks so important? Valente (2010, pgs. 3–7) says that relationships matter because
relationships influence a person’s behaviour above and beyond the influence of his or her attributes. A person’s attributes influence who people know and spend time with: their social network. Valente quotes Borgatti et al (2009), “One of the most potent ideas in the social sciences is the notion that individuals are embedded in thick webs of social relations and interactions”.

The reason that social networks are so important is because human beings are ultra-social animals that create social networks (Haidt, 2006). Syed (2010, page 110) concurs by quoting Geoffrey Cohen: “The need to belong, to associate, is among the most important human motives. We are almost certainly hardwired with a fundamental motivation to maintain these associations.”

Christakis and Fowler (2010, pg. 214) add that human beings just don’t live in groups, they live in networks. Valente argues the traditional social science approach of using random sampling is not adequate for measuring network concepts because random sampling removes individuals from the social context that may influence their behaviour. Valente explains that one primary reason social network research has grown in recent decades is that scholars have become dissatisfied with attributes theories of behaviour. Many attribute theories have not explained why some people do things (e.g. quit smoking) while others do not. Social network explanations have provided good explanations in these cases.

4. The Power of Visualisation

One feature of social network analysis is its ability to graphically represent a network. This allows the viewer to see relationships visually through both the whole network at once and parts of the network. But, visualisation can reveal key characteristics of a network that may be difficult to see otherwise as shown by the examples below.

Jackson (2012) researching the social networks of microfinance clients in India asked members of self-help groups individually who did the most work in the group. The resulting network diagrams or sociograms generated from the answers of two of the groups are shown below.
**Figure 1: Female Self-Help Group.**

The way to read the above network diagram is that the arrow points from the person giving the answer to who that person believes is doing the most work. In social network analysis terms, the arrows are known as ties or edges and the squares representing group members are called nodes. As is obvious from the network diagram, almost everyone has an arrow pointing to node 1. The exception is node 13 who did not answer the question and therefore no arrows. Further research confirmed the central role of node 1, the group leader, in this self-help group implied by the sociogram. She was seen as such an effective leader that not only did the group members depend on her, so did the other villagers which led her to feel overburdened. Most importantly, the sociogram indicates that if anything happened to node 1, this self-help group could be in danger of falling apart.
This male self-help group was founded by three friends who wanted to prove that men could successfully operate a self-help group. The three friends became group leader and deputy group leaders. As with the female self-help group, the group leader (node 1) has the most arrows pointed towards him. But, in this group, nodes 4 and 5 also have arrows pointed to them. These are the deputy leaders and indicate that if anything were to happen to the group leader, there are two deputies who could step in. This again was confirmed in interviews. While the sociograms below will be more complicated, the principals for analysing them by finding visual patterns will be similar to these two examples.

5. Social Network Analysis and History

So how can social network analysis be used in history? There has been a growing use of social network analysis in history recently. Wellman and Wetherell (1996) suggest to historians the usefulness of using a social network analytic approach to studying communities and community-like social structures such as kinship groups and work groups. One of the seminal works in historical network research is the study of how the Medicis
rose to power in Renaissance Florence by Padgett and Ansell (1993). Instead of focusing on formal institutions, groups and goals; Padgett and Ansell concentrated instead on the social networks operating in Florence at the time. There were four types of social networks investigated: marriage, economic, political and friendship. Padgett and Ansell were able to show that the Medicis, especially Cosimo Medici, rose to power in Florence by brokering among these four networks and being able to bridge the structural holes (Burt, 1992) in these networks to their benefit. It was the ability to use social network analysis to provide a view not available through traditional historical means that made this paper so influential.

Such studies encouraged increasing use of social network analysis in history. However Wetherell (1998) has identified three reasons why historians have been slow to adopt social network analysis. First, the conceptual orientation of historical social network analysis remains unfamiliar to historians. Second, quantitatively oriented historians are few in number. Third, social network analysis data requirements are formidable. These include the need for evidence of social interaction among all members of a social system for a variety of behaviours and the need for a broad range of high-quality records for the place, time and activities being studied. Finally, social network analysis is problematic for historians because they are plagued by an incomplete historical record and imperfect understandings of past social relations.


6. Limitations with Using Medieval Scottish Charters as Data

The thousands of medieval Scottish charters used as the main data for this from the eleventh to thirteenth centuries, in some ways are robust. However as with all historical documents, there are issues with the charters that introduce caution with its use. These include:

- There are a lot of missing charters. The survival rate is uneven. Most of the surviving charters come from eastern and southern parts of Scotland. This means that ‘true’ statistics are impossible, because we will never know what 100% looks like.
• Charters record transactions which may involve a ceremony (e.g. transferring land from one person to another) or may not (e.g. a concessio by the king of a previous transfer of land).
• They represent a moment of social interaction in which different groups (e.g. neighbours, families, lords, and officials) come together for a specific purpose.
• They can only give us access to social interaction in a specific context—namely the public acknowledgement of property and privileges.

7. Social Significance of Charter Witnessing

Historians have established that administrative documents such as charters were intended to represent actual social events, and have focused increasingly on better understanding the context of these events. The PoMS database incorporated ‘document type’ as a feature due to a recognition that different types of documents were produced in diverse circumstances and settings (Hammond 2013, pp. 8-13). Recent research across the medieval era has shown that many charters were produced at formal political assemblies (Reuter 2006, pp. 193-216). Our analysis of social networks has focused on charters strictly defined, as this is the document type which is most likely to represent a social moment when significant numbers of people came together in one location and interacted in a socially prescribed and structured way. Charters strictly defined, make up about 66% of the documents in the pre-1286 PoMS database. Furthermore, Dauvit Broun has determined that individuals named in charter witness lists were almost always physically present at the ‘ceremony’, whether a large political or ecclesiastical assembly or smaller event (Broun 2011). The act of witnessing a charter carried with it legal responsibilities in terms of the possibility of being called on later to testify to the veracity of the transaction of property that was the subject of the charter. Transfers of property in the medieval period were often challenged. Thus, the witnesses bore an implicit social relationship to the grantor, beneficiary, or the property being transacted, and were often friends, family, or neighbours of either the grantor or beneficiary. Thus, the role of being a charter witness is pregnant with social connections.
8. Two Research Tracks

This exploratory research has taken two tracks to investigate what networks can reveal about medieval Scottish society:

1. Creating a network of charters and witnesses to derive from that of a network of co-witnessing that will describe how many times two people have witnessed charters together and seeing what can be revealed by this network.
2. Comparing a list of opinion leaders created by traditional historical methods with a list generated using Valente’s (1995) method of using network density to identify opinion leaders. If the correlation is high enough then see if Valente’s method identifies opinion leaders that traditional historical methods do not.

9. Network of Charters and Witnesses

The largest amount of data from the People of Medieval Scotland database centres on the charters and the people who witnessed them. There are 3817 charters which were witnessed by 9078 people.

From this data, a network of charters and witnesses can be created. In social network analysis, this type of network is called a two mode network. Two mode networks show the relationships between two different sets of actors, in this case, charters and witnesses. Only relationships between the sets of actors are shown. For example, only connections between charters and witnesses are shown, never witness to witness or charter to charter.

However, we can see relationships within each set by generating affiliation networks which are created using mathematical techniques. In this case, an affiliation network of witnesses will indicate which people witnessed charters together and how many times they did so. The shared presence does not necessarily indicate that there is a social relationship between these two people. But, the more times two people witness charters together, the more probable there is a social relationship. Wasserman and Faust (1994) describe this method and two mode networks.

Figure 3: Network Diagram of Witnesses who have Witnessed at least 21 Charters with Other Witnesses.
The two mode network and the affiliation network for witnesses were created using the Pajek software created by Batagelj and Mrvar (2003). The network diagram was created using the Netdraw software tool (Borgatti, 2002) which is part of the UCINET toolset (Borgatti et al, 2002).

Figure 3 was generated by asking Netdraw to show all witnesses who had witnessed at least 21 charters together. While this number of charters was an arbitrary choice, it was felt that this number there was a good probability that real social relationships would start to be revealed. If the number of charters witnessed together was much lower than this, it may only be that these witnesses were only present together and the probability of having a social relationship was low.

In Figure 3, the lines or edges connect people who have witnessed at least 21 charters together. The different symbols representing the people or nodes is a result of Pajek trying to give each person a unique symbol. The numbers next to the node is the person identification in the People of Medieval Scotland database. The two most noticeable features of the network diagram is the main component roughly shaped like a “T” and to the left of it is a group of 7 people.
The group of 7 contains three cliques. In social network analysis, a clique is a part of the network where all of the members are connected to all the others. It has a minimum of three members (Wasserman and Faust, 1994). In clique 1, there are nodes 48, 49, 835 and 2971. In clique 2, there are nodes 835, 2491, 2971 and 3511. In clique 3, there are nodes 835, 2971 and 3871. Notice how nodes 835 and 2971 are in all three cliques.

What is keeping these cliques together? Georg Simmel theorised that it was a shared group norm that kept a triad or three member clique together. He also said that this applied to cliques of four or more members (Ritzer, 2008, pp 158 – 188). So, what was the group norm that kept these three overlapping cliques together? It turns out that all of the people in these cliques were either in ecclesiastical positions or were employed by the clergy. All of the at least 21 charters witnessed by these people involved the internal transfer of property within the church. Which is why this is not connected to the main component since non-church people did not regularly witness such charters. While traditional historical methods could have discovered this, the use of social network analysis speeded up the process considerably.

The cross bar of the main component serves as a timeline with the witnesses of the oldest charters at the right end and the witnesses of the newest charters at the left end. The witnesses on the vertical part of the main component are associated with charters involving Coldingham. Node 42, which connects all three parts of the main component, is William del Bois the chancellor, who is responsible for processing the charters. It is no surprise he has witnessed charters with 470 people.

However, the big surprise was node 13 in the centre of the right arm of the main component. This is Duncan II, Earl of Fife, who has witnessed charters with 630 other people. Not only that but while William del Bois has witnessed at least 21 charters with 15 other people, Duncan II has witnessed at least 21 charters with 27 people. Why is Duncan so much better connected as far as charter witnessing is concerned compared to William del Bois? In addition to being Scotland’s top earl and a key ally of the royal house, Duncan was earl for fifty years (1154-1204, although he was still a minor for the first five years or so). He also acted a royal justice for much of this time. Nevertheless, Duncan’s position eclipses other earls and other royal justices. The extent of Duncan’s network, even understanding these factors, was not previously guessed at and it may be that Duncan acted as a bridge between various groups. Duncan may have effectively been running the country in the core region of ‘Scotland’ north of the Forth for several
decades. It is unlikely this would have been discovered without the use of social network analysis.

10. Finding the Opinion Leaders

In this research track, we will attempt to see if social network analysis can identify opinion leaders who help to spread the innovation of the use of the Scottish Regnal \textit{Sicut} clause in charters starting in the mid-twelfth century where traditional historical methods cannot. First, there will be a discussion on the Scottish Regnal \textit{Sicut} clause. This will be followed by a discussion of both the diffusion of innovations theory and an associated network theory. Finally, the results of using network theory to identify opinion leaders will be described. Because the PoMS database has been designed to reflect the formal structure of medieval charters, it is possible to test out the diffusion of innovations model using the spread of a particularly significant feature of Scottish charters. This is the ‘Regnal \textit{Sicut} clause’. A \textit{Sicut} clause describes the terms of the holding of property through reference to the terms by which such possessions were held by others, within a specific geographical area. The Regnal \textit{Sicut} clause then, is a statement that a church, settlement or other property is to be held as freely, peacefully and honourably (or suchlike) as any other equivalent property \textit{in regno Scotie} or \textit{in regno Scottorum} (‘in the kingdom of Scotland’ or ‘in the kingdom of the Scots’). This is significant because in the twelfth century, the term ‘Scotland’ only referred to a portion of the modern country, roughly between the Firth of Forth and the River Spey. The king of Scots ruled over, or claimed to rule over a variety of distinct lands, and the earliest \textit{Sicut} clauses refer to these, for example, Lothian (southeast Scotland). Historically, the king had different types of authority in the different lands depending on the extent of his power and the local legal customs. Over the course of the late twelfth and thirteenth centuries however, the kingdom became more centralised and royal power more uniform (though still much less than in England). The Regnal \textit{Sicut} clause is important because it demonstrates this process in action. Because the clause was optional and never a legal requirement, the decision to include it in one’s charter demonstrates the diffusion of a very important innovation in terms of the development of a cohesive Scottish realm – the means by which individuals thought of their property as existing within the legal framework of the kingdom of Scotland.

The earliest charters to employ the \textit{Sicut} clause were referring to the kingdom of Scotland/ the Scots date to the 1150s and 1160s. The grantors of
the charters are characterised by their closeness to the king. Countess Ada was mother of King Malcolm (1153-65) and William (1165-1214). Walter son of Alan and Richard de Moreville were the king’s steward and constable, respectively. Duncan (II) earl of Fife, and Richard bishop of St Andrews, were the top secular and ecclesiastical figures in ‘Scotland’, strictly defined (i.e. between Forth and Spey). Furthermore, Duncan was a long-serving royal justice, while Richard had previously been one of the king’s chaplains. Successors to these offices of bishop of St Andrews, steward, and constable also used the clause, although not all royal officials chose to do so. Successive generations saw continuing use of the clause by the successors to these offices and their equivalents, such as the king’s brother, Earl David, and a number of earls, bishops, and knightly landholders. A noteworthy grouping was landholders near the border with England, particularly in Roxburghshire.

This research combines social network analysis and the theory of the diffusion of innovations. The theory of the diffusion of innovations was created by Rogers (2003) and explains how change spreads through a population. Using Roger’s work, Valente (1995) proposed several models of how innovations diffused through a network. Two of these were used in this research. First, in the opinion leadership model, Valente proposes that opinion leaders in the network would tend to be early adopters of innovations. Second, the network density model said that those with lower ego network density would also tend to be early adopters of innovations. Network density is the ratio of the actual connections in the network over the total potential connections in the network. Based on the work of Granovetter (1973), Valente argues that weak bridging ties bring new information into the network and those with lower network densities tend to have weaker bridging ties. Granovetter (1973) defines weak bridging ties as connections between different groups that allow information and behaviours to spread throughout a population. This also explains why opinion leaders are early adopters because they tend to have lower network densities.

A question that arises about the diffusion of innovations is if people are rational economic decision makers, why aren’t advantageous innovations adopted universally? These aren’t because of social, structural and psychological factors. Some of these include network effects.

Valente says there are two basic network models for diffusion. First are relational network models where diffusion occurs through interpersonal influence flowing through direct ties and second are structural network models where diffusion occurs by interpersonal influence being a function of
an individual’s position in the network. Opinion leadership is one type of relational network models. This type follows a two-step hypothesis where opinion leaders tend to be early adopters. Other individuals then follow the lead of the opinion leaders. There is research that shows that more advantageous innovations are likely to be adopted earlier by central figures in the network. However, group norms impact how opinion leaders act on innovations.

Another type of relational network model uses personal and network density. This is to the degree an individual’s personal network is interconnected. This is similar to ego network density. The denser this network, the more likely the individual is a late adopter of innovations. This is the ‘Strength of Weak Ties’ argument of Granovetter (1973) that is discussed above. Those with high ego network density tend not to get the latest information. This also follows Burt’s argument on closure (1992). Those with radial ego networks tend to have Granovetter’s ‘weak ties’ and have the latest information and tend to be early adopters.

11. Testing to see if Social Network Analysis can Identify Opinion Leaders

Because of the uncertainty of the dating of the charters, it was not possible to do a traditional diffusion of innovation study by building a communication network to see how the innovation of the Scottish Regnal Sicut clause travelled through the network over time. Instead, Valente’s (1995) network density type of relational network model would be tested to see if by using the People of Medieval Scotland database it could identify opinion leaders.

The first step was to use traditional historical methods to identify the opinion leaders who were involved in the diffusion of the Scottish Regnal Sicut clause as described above. The opinion leaders identified by traditional historical methods are: Duncan II, Earl of Fife; Walter, son of Alan; Richard de Moreville; Bishop Richard of St Andrew and Countess Ada. Walter of Lundin, Waltheof son of Cospatric and Malcolm- Earl of Atholl were identified as possible opinion leaders.

The network built using the charter co-witnessing of all 9078 witnesses in the database was used to generate the ego network density for all of the possible opinion leaders. These densities were put in ascending order. There is a strong correlation between those identified by traditional historical
methods highlighted in black and those identified by relatively low ego network density as can be seen in Table 1.

This network density type of relational network model was also able to identify Malcolm, Earl of Atholl (bold and underlined) and Walter of Lundin as potential opinion leaders. The model eliminated Waltheof and Robert of London (in italics) as opinion leaders.

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Density in Witness Network</th>
<th>Historical Opinion Leader?</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Duncan Earl of Fife</td>
<td>8.47</td>
<td>Y</td>
</tr>
<tr>
<td>3</td>
<td>Walter son of Alan (Steward)</td>
<td>15.17</td>
<td>Y</td>
</tr>
<tr>
<td>112</td>
<td>Richard de Moreville</td>
<td>20.64</td>
<td>Y</td>
</tr>
<tr>
<td>134</td>
<td>Bishop Richard of St Andrew</td>
<td>22.94</td>
<td>Y</td>
</tr>
<tr>
<td>970</td>
<td>Walter of Lundin</td>
<td>31.97</td>
<td>M</td>
</tr>
<tr>
<td>95</td>
<td>Countess Ada</td>
<td>32.05</td>
<td>Y</td>
</tr>
<tr>
<td>966</td>
<td>Henry Revel</td>
<td>32.41</td>
<td>N</td>
</tr>
<tr>
<td>238</td>
<td>Malcolm Earl of Atholl</td>
<td>35.42</td>
<td>M</td>
</tr>
<tr>
<td>855</td>
<td>Bernard son of Brian</td>
<td>41.41</td>
<td>N</td>
</tr>
<tr>
<td>575</td>
<td>William of Lamberton</td>
<td>61.54</td>
<td>N</td>
</tr>
<tr>
<td>6175</td>
<td>Richard Gordon</td>
<td>90</td>
<td>N</td>
</tr>
<tr>
<td>1335</td>
<td>Waltheof son of Cospatric</td>
<td>100</td>
<td>N</td>
</tr>
<tr>
<td>13595</td>
<td>Robert of London</td>
<td>100</td>
<td>N</td>
</tr>
<tr>
<td>1399</td>
<td>Margaret, Henry Revel's wife</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>13892</td>
<td>Richard Lovell, Lord of Hawick</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1 - Network Density Test for Witness Network: Y = Yes, N= No, M = Maybe**

12. **Summary**

In summary, while this research is still preliminary, it has shown the power
of social network analysis to bring a new perspective to historical data:

• It has shown how Duncan II, Earl of Fife, is even more important than first thought due to his high degree of connectedness in witnessing charters in Scotland.
• Using ego networks, we are able to identify possible new opinion leaders that played a key role in diffusing the Scottish Regnal Sicut clause innovation in charters

The strong correlation between the list of opinion leaders generated by traditional historical methods and the list generated by using the network density relational network model generated one additional benefit. It was unclear at the start of this research how much the affiliation network of charter witnesses reflected the social reality of twelfth and thirteenth-century Scotland. The affiliation network could have been only an artefact of the charter data that had a good deal of missing data. The strong correlation gave confidence that this network may actually reflect the Scottish social relations at the time.

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