

Imprint

Université du Luxembourg 2024

Luxembourg Centre for Contemporary and Digital History (C²DH)

Université du Luxembourg

Belval Campus

Maison des Sciences Humaines

11, Porte des Sciences

L-4366 Esch-sur-Alzette

Editors

Asst. Prof. Dr. Marten Düring (Luxembourg Centre for Contemporary and Digital History | C²DH)

PD Dr. Christian Rollinger (Universität Trier)

Dr. Cinderella Petz (IEG – Leibniz-Institut für Europäische Geschichte)

Dr. Ingeborg van Vugt (Königlich Niederländische Akademie der Wissenschaften)

Clemens Beck, M. A. (Friedrich-Schiller-Universität Jena)

ISSN 2535-8863

Contact

Principal Contact

JHNR-editors@historicalnetworkresearch.org

Support Contact

Dr. Marten Düring (Université du Luxembourg)

JHNR-support@historicalnetworkresearch.org

Cover Design and Typesetting

text plus form, Dresden, Germany

Cover image

Martin Grandjean

Copyediting

Andy Redwood, Barcelona, Spain

Published online at

<https://doi.org/10.25517/jhnr.v10i1>

This work is licensed under a Creative Commons License:

Attribution-NoDerivatives 4.0 (CC BY-ND 4.0)

This does not apply to quoted content from other authors.

To view a copy of this license, please visit

<https://creativecommons.org/licenses/by-nd/4.0/deed.en>



MARKUS ELDEGARD MINDREBØ

Simulating medieval connections

Grand strategy games and social network analysis

Journal of Historical Network Research 10 (2024) 92–121

Keywords Network analysis, game studies, simulation, kinship, saga

Abstract This article explores the potential of relationship-based computer games as simulation software for qualitative network research, using a case study on the inter-personal dynamics of medieval aristocratic networks, with the Old Norse-Icelandic sagas (12th–13th c.) as its source material. It shows how video games can be helpful in qualitative readings of medieval networks, their progression, and their internal motivations, on a temporal, interactive basis. One of the key characteristics of strategic games is the endowment of non-player characters (NPCs) with attributes which are reflected in an algorithm that determines the outcomes of a given interaction; the algorithm predicts conflicts and network patterns when characters with different attributes engage with one another. NPC modelling offers a distinctive way of analyzing relationships within medieval networks: how, when, and why they develop, progress, and disintegrate. This tool could be game-changing in fields of pre-modern network studies more broadly, as it would allow for the repeated modelling of network structures in historiographical narratives, altering variables to assess the possible impact of different types of network formation, political priorities, strategies of kinship and the pathways open to agents, resulting in the ability to filter research questions and hypotheses with which to return to the original evidence.

Introduction*

In the late 9th century, according to the later medieval kings' saga *Heimskringla*, Haraldr 'hárfagri' ('Fairhair') unified Norway under himself. Haraldr became the country's first individual king, by allying with, manipulating, marrying into, and/or defeating the region's various pre-existing elite groups and networks, allegedly after contesting a final battle in southwestern Norway.¹ In Swedish game developer Paradox Interactive's *Crusader Kings II*, I started a simulation to follow Haraldr's actions. While he did successfully found the Norwegian kingdom, the final battle took place a decade later than the sagas suggest, in the Faroe islands rather than in southwestern Norway, and only occurred after he took a detour to capture some Frankish provinces in modern-day Belgium. One might see this divergence as clear evidence of a limitation, as proof of the game's inability to reflect medieval historiography; or, one might recognize that the digitized Haraldr's relative success means that the game's algorithm has, to a certain extent, accurately reflected his motivations, and thus predicted his actions. Neither a 13th century written record nor a 21st century digital game provides an accurate reflection of 9th century realities, but there is a strong incentive to use the latter to inform investigations into the formation and weaponization of interpersonal relationships in the former. Haraldr's success, like many endeavors, hinged on his ability to establish and maintain wider networks of such strategic relationships.² The Haraldr of my game simulation, like the Haraldr of the source material, built his dynasty with many children, assigned rewards to loyal allies and followers, maintained good relations with the factions at his back, and crafted ties of marriage and concubinage with other families. While the artificial intelligence that takes his place in the game is never going to completely correspond to either the source material or the potential historical reality, what we have is thus a unique opportunity to reconstruct, play around with, and investigate the intricacies of medieval network organization and development, in a continuously fluid rather than static sense. Further, the real value of this approach lies first and foremost in its unique potential for collecting simulation data, interpreting deviations from the source

* **Acknowledgements:** I would like to acknowledge the generous support of the European Research Council-funded CONNEC project for funding the research behind this article. I would also like to mention the support of various colleagues, including David Natal, Kate Cooper, Robert Houghton and Simon Trafford, for contributing to the ideas behind it.

Corresponding author: Markus Eldegard Mindrebø, University of Stavanger, Norway, markus.e.mindrebo@uis.no

1 Bjarni Aðalbjarnarson, *Heimskringla I*. (Reykjavik: Hið íslenska fornritafélag, 2002), 94ff. Haraldr's historicity is highly debated, as shown, for instance, in Sverrir Jakobs-son, "The Early Kings of Norway, the Issue of Agnatic Succession, and the Settlement of Iceland," *Viator* 47, no. 3 (2016): 171–88.

2 Martin Kilduff & Wenpin Tsai, *Social Networks and Organizations*. (London: Sage, 2003), 1–2.

material, and highlighting new research questions with which to re-examine the usefulness and weight of interpersonal connections within the source material. Networks built from historical sources, such as Haraldr's network here, are often incomplete and full of broken links, ghost nodes, and obscured processes.³ The overall aim of this article is to show, through the development of an initial framework and a brief confined case study, how the complexity of network dynamics in *Crusader Kings II* is well-suited as a platform for the creation of a heuristic network research tool for historians, enabling reconstructing and further theorization of network formation, primarily for qualitative primary research, but emphasizing both specific connections and the nature of these connections as examples of a political structure in the sources.⁴ This article thus follows Robert Morrissey in deeming that social network analysis "*is powerful but must be paired with traditional historical methods to be most effective*,"⁵ but is simultaneously rooted in Tom Brughmans' principle that even a highly qualitative SNA must consider the wider structural implications.⁶

This approach aims to begin to integrate games and network methodology for historical research, and thus proposes to start thinking of games as potential network software. While the past two decades have seen an increase in the inclusion of video games in teaching, less attention has been devoted to the potential of complex game-based simulations as reading tools to aid investigative work.⁷ And while networks of game players have been investigated as a social phenomenon, networks of in-game characters have largely been ignored.⁸ Here, much remains to be utilized, particularly when academic historians can take a game and modify it according to our own purposes. To begin facilitating such an effort, I will here develop and set out a methodology for the use of complex relationship-based video games as tools for investigating the inter-personal dynamics of medieval

3 Søren M. Sindbæk, "Broken Links and Black Boxes: Material Affiliations and Contextual Network Synthesis in the Viking World" in *Network Analysis in Archaeology: New Approaches to Regional Interaction*, ed. Carl Knappett. (Oxford: OUP, 2013), 77.

4 It must be noted that at the time of writing, a sequel, *Crusader Kings III*, has been published. This article has made the conscious choice to use the older version given its additional development and additional possible starting points, alongside the more extensive options to internally modify the simulation for research purposes with the application of the in-game console.

5 Robert M. Morrissey, "Archives of Connection: "Whole Network" Analysis and Social History", *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 48, no. 2 (2015): 67–79.

6 Tom Brughmans, "Connecting the Dots: Towards Archaeological Network Analysis", *Oxford Journal of Archaeology* 29, no. 3 (2010): 298.

7 Kevin Schut, "Strategic Simulations and Our Past: The Bias of Computer Games in the Presentation of History", *Games and Culture* 2, no. 3 (2007): 214 ff.

8 Cuihua Shen, Peter Monge & Dmitri Williams, "Virtual Brokerage and Closure: Network Structure and Social Capital in a Massively Multiplayer Online Game", *Communication Research* 41, no. 4 (2014): 459–80.

aristocratic networks, the targeted payoff being the collection of data and the resulting triggering of otherwise underutilized research questions with which to return to the original evidence.

The problem with investigating network progression is that network analysis is often static, mapping out networks at specific points in time rather than being able to track their development.⁹ Using multi-faceted, extensive strategy games as simulation software enables combining the complexity of social network analysis with both the temporal aspect of simulation and the interactivity of a player-influenced environment, hence moving the method from the static mapping of historical networks based on recorded data, towards drawing out the potential eventualities of the agents involved and thus enabling further theorization of the properties and features of the networks around them. One of the key characteristics of strategic games is the endowment of non-player characters (NPCs) with attributes which are reflected in an algorithm that determines the outcomes of interaction; the algorithm predicts conflicts and network patterns when characters with different attributes engage with one another. NPC modelling thus offers a distinctive means of interrogating relationships within medieval networks: how, when, and why they develop, progress, and disintegrate. Again, the overall goal is to produce a rudimentary framework that is useful for the purposes of game scholars and network scholars alike, which can contribute to further illuminating the inner workings of past social networks and the intra-group and inter-group behaviors of their members, as an exploratory first step towards full integration, modification, and expanded use. Here presented in limited forms (but with more extensive applications in future work), a complex game simulation can thus serve as a highly useful research tool for scholars of medieval texts who deal with interpersonal networks.

9 Shawn Graham & James Steiner, “TravellerSim: Growing Settlement Structures and Territories with Agent-Based Modeling” in *Digital Discovery: Exploring New Frontiers in Human Heritage*, ed. Jeffrey T. Clark and Emily M. Hagemester. (Budapest: Archaeolingua, 2008), 61. Søren M. Sindbæk, “The Small World of the Vikings: Networks in Early Medieval Communication and Exchange”, *Norwegian Archaeological Review* 40, no. 1 (2007): 70.

Theoretical framework

Overall, the defining characteristic remains the same as with any social network analysis.¹⁰ The goal is to figure out the aggregate characteristics of systems from the connections of their individual parts,¹¹ as well as to synthesize networks where we are unaware of all the parts.¹² The only difference here lies in the increased emphasis of the behavior of these parts over time.¹³ In its essence, such a goal fits well with longstanding definitions of research simulation.¹⁴ The connection between the usage of simulation models for historical research and the usage of historically rooted strategy games for popular entertainment is strong, and scholars have even attempted to use game simulation itself as a tool for reading history in the past.¹⁵ Over time, this kind of digital scholarship has in many cases been morphed into agent-based modelling (ABM),¹⁶ characterized by “a set of actors or agents, an environment and processes specifying how agents interact with the environment and other agents.”¹⁷

Inspired by agent-based modelling theory, we can create frameworks for studying the relationship of an individual to a collective, e.g., a wider interpersonal network, and the internal processes of such collectives. As such, we may utilize similar theories to identify not just the specific bonds and arrangements made by two or more individuals, but the way in which these bonds develop and form wider group-based goals and progressions of collective action. Through using simulations of action and interaction by groups of autonomous agents, we can follow and track these actions and interactions in order to dynamically inter-

-
- 10 For an introduction to social network analysis for historians, see Kilduff & Tsai, *Social Networks*; Morrissey, *Archives of Connection*; Brughmans, *Connecting the Dots*; Tom Brughmans, Anna Collar and Fiona Coward, “Network Perspectives on the Past: Tackling the Challenges” in *The Connected Past: Challenges to Network Studies in Archaeology and History*, ed. Tom Brughmans, Anna Collar & Fiona Coward (Oxford: OUP, 2016). On network analysis and Scandinavian historiography, see Sindbæk, *Small World*; Pádraig MacCarron & Ralph Kenna, “Network Analysis of the *Íslendinga sögur* – The Sagas of Icelanders”, *European Physical Journal B* 86, no. 10 (2013). Pádraig Mac Carron & Ralph Kenna. “Viking sagas: Six degrees of Icelandic separation – Social networks from the Viking era”, *Significance* 10, no. 6 (2013).
 - 11 Brughmans, *Connecting the Dots*: 277–8; Morrissey, *Archives of Connection*: 72
 - 12 Sindbæk, *Broken Links and Black Boxes*: 75–6
 - 13 Mark W. Lake, “Explaining the Past with ABM: On Modelling Philosophy” in *Agent-based Modeling and Simulation in Archaeology*, ed. Gabriel Wurzer, Kerstin Kowarik and Hans Reschreiter (Berlin/New York: Springer, 2015), 4.
 - 14 Robert E. Shannon, *Systems Simulation: The Art and Science*. (Englewood Cliffs: Prentice-Hall, 1975), 2.
 - 15 See particularly the collection in Kiyoshi Arai, Hiroshi Deguchi & Hiroyuki Matsui, *Agent-Based Modeling Meets Gaming Simulation*. (Tokyo: Springer 2005).
 - 16 For the connection of ABM and SNA, see Graham & Steiner, *TravellerSim*: 60–61.
 - 17 Wendy H. Cegielski & J. Daniel Rogers, “Rethinking the Role of Agent-Based Modelling in Archaeology”, *Journal of Anthropological Archaeology* 41 (2016): 298.

pret the wider system in which they occur.¹⁸ The goal, to use a formulation that Cegielski and Rogers use for ABM, is “to understand power negotiation in past societies through actions of individuals focusing on one particular style of socio-political organization – the socio-political hierarchy.”¹⁹

At one intersection between historical network analysis and research simulation, I argue, stands the form of complex gameplay we find in the *Crusader Kings* series of games – medieval dynastic simulators where a player takes control of an aristocratic dynasty one individual at a time, changing upon death to said individual’s heir and successor, all the while making interpersonal, political choices in relation to other characters in the simulator, both within and outside their specific dynasty. At any given point during the real-time simulations, the player makes such choices by clicking on the relevant tabs referring to their own or other characters, accepting or declining proposals by AI-controlled characters, and increasing their various scores (in terms of abilities, influence, and most importantly interpersonal connections) through these actions as well as world events. Unlike other medieval-focused strategy games, these games can be defined as network managers, and as with social network analysis more generally, we can use them to analyze behavior through investigating relationships.²⁰ *Crusader Kings II* (2012) has previously been read by scholars as an unusually accurate depiction of the medieval era, including in its complex portrayal of interpersonal and political mechanics. It stands out for its recognition of individual and group relationships as perhaps the most vital component of medieval politics and conflict.²¹ This game is not the perfect system for historical research (it is, after all, created and monetized for entertainment purposes first, and intellectual usefulness only a distant second), but nonetheless it is a system that provides a unique opportunity for this particular research avenue. The long-term goal must be the development of software exclusively dedicated to the mapping out of historiographical networks, beginning with a scholarly driven modification of the game system. Even as it stands, however, the game will serve as an example case study from which to build a methodology both for immediate use and for future development, as is the aim here.

18 *ibid*: 284–5; Graham & Steiner, *TravellerSim*: 58.

19 Cegielski & Rogers, *Rethinking the Role*: 285

20 Morrissey, *Archives of Connection*: 71

21 Bertrand Lucat & Mads Haahr, “What Makes a Successful Emergent Narrative: The Case of *Crusader Kings II*.” in *Interactive Storytelling*, ed. Henrik Schoenau-Fog et al. (Berlin: Springer, 2015), 261–4.

The advantages of the *Crusader Kings* system

It is essential for the advancement of historical network analysis, as per Johannes Preiser-Kapeller, “to deploy concepts and tools which allow us to systematically survey, map and analyse [...] individuals and their social ties in order to unravel some of the underlying mechanisms of political conflicts.”²² The form of historical network simulation proposed here allows us to see emergent new structures in existing interpersonal patterns and the activity patterns of agents, in this case social webs of network and alliance structures (or enemy structures). The overall goal thus becomes the theoretical extrapolation of social relationship networks in medieval historiography, using the mechanics of *Crusader Kings II*. The game itself, intended as a simulation allowing players to craft narratives based on their chosen characters’ interaction with others, is ideally suited for network-based readings of character-centric literary historiography. It is worth repeating that the purpose of this study is not so much to use the game to provide an accurate depiction of how specific medieval individuals behaved, but rather to engage with medieval writers’ understanding of networks and further analyze the political potential of network connections in medieval historiography based on the collected data.

First of all, networks in the game world largely constitute a small-world phenomenon: while there are a large number of individuals, most characters in the game have direct or indirect connections to each other.²³ Second, and tied to the first point, the game uses an extensive collection of behavioral *traits* as both character descriptors and defining characteristics. These traits are responsible for outlining both a character’s individual personality and a significant part of the motivations behind their actions. For example, a character with the ‘Vengeful’ trait may be quick to declare war on another character over a past slight. A character with the ‘Pious’ trait will be more likely to abide by the decisions of the Church, and to participate in religious missions. It is important to note that these traits can be defined by multiple criteria. Innate traits (such as those involving physical attractiveness, and to some extent innate intelligence) can be passed down genetically, but are often also randomly assigned based on chance at birth. Personality traits are primarily influenced by a character’s education as a child (in the game influenced by who is selected as the child’s guardian or foster-parent). Finally, traits are also gained by event chains where the individual character’s choices also come to define part of their personality. It is these traits, then, which are predominantly responsible for prescribing a character’s socio-political goals.

22 Johannes Preiser-Kapeller, “The Ties that Do Not Bind: Group formation, polarization and conflict within networks of political elites in the medieval Roman Empire”, *Journal of Historical Network Research* 4 (2020): 315.

23 Duncan J. Watts, “Networks, Dynamics, and the Small-World Phenomenon”, *American Journal of Sociology*, 105, no. 2 (1999): 495–8; Sindbæk, *Small World*: 61.

While traits lie at the heart of the characters'/agents' agenda, the second key component defining these, particularly in the socio-political sense at the heart of network analysis, is the opinion system. *Crusader Kings* offers a setup where every single character in the game has a numerical opinion value (ranging from 100 to -100) related to every other character in the game.²⁴ While the emotional aspect of this puts it close to the sagas' and other medieval texts' depictions of agent motivation, it is certainly not purely emotional. Characters' opinions of each other are defined by numerous complex factors, including familiarity, bonds of kinship, religion, trait compatibility, friendly/hostile actions, gifts, and so forth. The numbers behind these are relatively transparent and can be found with ease both in the game engine and in various online guides. For example, characters who both possess certain traits will receive a 5-point bonus to relations, and characters with what are considered "opposite" traits suffer a negative 5-point penalty. Characters of different religions suffer a 20-point penalty in relation with each other, but a Christian character with the 'Sympathy for Pagans' trait removes this penalty both ways. Actions such as killing a relation or sending a gift will have a baseline sum of increased/decreased opinion, but will vary according to many modifiers, such as the Diplomacy skill of the actor. Tyrannical actions by a ruler, such as unlawful imprisonment or executing a prisoner, will be met with 40-point and 10-point penalties, respectively, to relations with all subjects. On the other side of the equation, a high or a low numerical opinion value will help determine a character's actions and choices in interpersonal relationships. An individual who has sworn allegiance to another but has a low opinion of them will be more inclined to betray his allegiance; kinsmen with claims to the same title may find themselves cooperating or clashing based on opinion values. An advantage of this system lies in the idea that political and social priorities can be tracked beyond tactical choices. While *Realpolitik* remains at the heart of such games, the pursuit of increasing power, wealth and land for oneself and one's family, the approval system presents a possibility to include personal relationships in the assessment of the agents' choices. It means, in essence, that the game, like much of medieval historiography, allows us to see a complex combination of emotional, tactical, and strategic choices and actions as part of a pure cause-and-effect narrative and, perhaps more importantly, allows us to identify those causes and effects in each particular case, enabling useful categorization.

The game itself, *Crusader Kings*, is ideally suited for network analysis. More so than other models and other games, it enables the consistent reading of contextual parameters for individual characters, and indeed, the characters of *Crusader Kings* fall extremely close to Cegielski & Rogers' definition of an agent for research simulation purposes as "a collection of behavioral rules and attributes that represent its identity".²⁵ Again, in this game and this study, all the agents are

24 *ibid.*

25 Cegielski & Rogers, *Rethinking the Role*: 285.

individuals, and all the individuals are agents, simulated as autonomous pieces of software (although we can, should, and will, choose to single out a certain group/ collection of characters to track for each individual study).²⁶ *Crusader Kings'* characters also fulfil all the requirements of agents as per Ferber:

agents need to be

- 1) autonomous and directed by their own objectives,
- 2) goal-directed or consistently attempting to achieve these objectives,
- 3) reactive, or able to change their behavior according to changes in the environment, and
- 4) situated in a specific location in the environment.²⁷

These are all evident in the game: any agent not controlled by the player will be located in a specific geographical location based on where their power base lies, and will attempt to build on their power base from there. Further, I would suggest that the entire game is structured around the idea (also found in network studies, as illustrated by Preiser-Kapeller) that conflict is typically the result of breakdowns within elite networks, because of, rather than in spite of, the needs that network members have from their connections.²⁸

The selection of material

In this article, I will be using such networks as represented in the Old Norse-Icelandic kings' sagas, my own area of research, as the foundational case study and example.²⁹ While large swathes of medieval historiography might be suitable for this kind of simulation experiment, as the sources often deal with network-run environments and pre-state structures, the sagas are particularly good examples given their wide range of characters and frequent emphasis on interpersonal relationships over time.³⁰ While many of the legal mechanics of the game are inspired by the feudal systems of continental Europe, a point to which I return below, the interpersonal mechanics are, as we shall see, ideal. I have opted to fol-

26 Graham & Steiner, *TravellerSim*: 58.

27 Jacques Ferber, *Multi-Agent Systems: An Introduction to Distributed Artificial Intelligence* (Harlow: Addison-Wesley, 1999), 9–10.

28 Preiser-Kapeller, *The Ties that Do Not Bind*: 306–7.

29 Markus E. Mindrebø, *The Bonds of Power: Women's Political Participation in the Sagas of Norwegian Kings, c. 950–1200*. (Unpublished PhD thesis: London, 2021). The thesis was heavily influenced by the theories and frameworks of Gerd Althoff, *Family, Friends and Followers: Political and Social Bonds in Early Medieval Europe* (Cambridge: Cambridge University Press, 2004).

30 An attribute which has led to sagas being used as focal points of social network analysis, even by scholars in the field of applied mathematics; see MacCarron & Kenna, *Network Analysis of the Íslendinga sögur*; MacCarron & Kenna, *Six Degrees of Icelandic Separation*.

low the most politically oriented of the saga sub-genres, the 13th century kings' sagas, particularly Snorri Sturluson's *Heimskringla* (c. 1230).³¹ The reader who wishes to utilize these methods may, however, wish to focus on their own source material, of which there could be many examples.³² The reasons for my selections here, nevertheless, should make it clear why the methodology has been framed with the saga literature in mind. A historiographical genre should at least fulfil some basic requirements:

- 1) The material ought to be politically driven in nature, or closely following political developments.
- 2) The material must track specific individuals over extended periods of time, and follow their interactions with each other, thus chronicles or annals are likely less suited for this purpose.
- 3) One must be able to extrapolate, divide and categorize interpersonal bonds from the material so as to be able to systematically track them in the simulation.

The way the game parameters restrict agents, and consequently the available strategies the game leaves them, means that the repertoire of a *Crusader Kings II* character falls remarkably close to the modus operandi of leading saga network figures. First and foremost, an agent in both media has the opportunity to engage in a set of primary strategies for expanding their network through the bonds of kinship, friendship and lordship³³ (marriage, fosterage, alliance, friendship, feasts, gift-giving, and vassalage), and for the removal of rivals through violent means (direct conflict/war, political assassination, imprisonment and exile). These all exist as character options in the game, and can simultaneously be directly linked to the choices and options of saga characters.³⁴

Nevertheless, while the sagas track many different forms of network cooperation through Old Norse-Icelandic terminology, this is for obvious reasons not always possible in a game simulation. Certain connections are easily tracked, and *Crusader Kings* uses a particularly complex diplomacy system. Agents can initiate vertical bonds similar to those found in medieval sources (although always

31 For a survey of the text and its characteristics, I refer to the comprehensive, seminal study of Sverre Bagge, *Society and politics in Snorri Sturluson's Heimskringla* (Berkeley: University of California Press, 1991).

32 Similarly political narrative sources (with an appropriately condensed timespan and character selection) with which the author is familiar include sources in Latin such as the *Gesta Danorum* of Saxo Grammaticus, and the Byzantine political historiography of the eleventh century, including Michael Psellos and John Skylitzes.

33 I am once again indebted to Althoff, *Family, Friends and Followers*, for this useful categorization.

34 See here my own terminological exploration of saga networks; Mindrebø, *The Bonds of Power*: 27 ff.

denoted with the feudal terms vassal and liege). The game also utilizes multiple formalized horizontal agreements between two agents (offered by one and then either accepted or rejected by the other), such as non-aggression pacts and alliances (which require either kinship or a non-aggression pact). These are easily tracked within the simulation, as characters will have such relationships listed on their character page. However, in order to better reflect the complex and flexible paradigm of medieval historiography, we can also track less formal forms of alliance by reading the game according to the same principles we would use to read our sources. Multiple instances of cooperation between two agents can be counted as an alliance.³⁵ While this is less formal than a declared pact, both in source material and game environment, it allows us to read individual agents as being part of each other's cooperative networks without having to rely on the game's formalized bonds. There are consequently multiple criteria for how network bonds and leadership can be determined, but in the more complex medieval social structures, and game parameters, of *Crusader Kings*, we have a significant pre-set framework in terms of formalized alliances, marriages and social network bonds which can be read in conjunction with the network bonds described in medieval narrative histories.

The literary writing style of the sagas adds a further edge for this particular kind of simulation research. Emotions, as well as behavioral characteristics, are frequently used in descriptions of kings and other characters and are often tied to their behavior around and communication with their connections, closely corresponding to the game's aforementioned trait system. Practically all valued traits in the saga society are represented in the game (a character being 'Ambitious', 'Brave', 'Charitable' and so forth), and the same is true for traits considered more threatening in the sagas (e.g. 'Cruel', 'Greedy', 'Deceitful'). As an example, we can examine *Heimskringla's* description of two characters we shall return to in the experimental simulation below, King Eiríkr 'blóðøx' ('Blood-axe') and his wife Gunnhildr:

*“Eiríkr var mikill maðr ok fríðr, sterkr ok hreystimaðr mikill, hermaðr mikill ok sigrsæll, ákafamaðr í skapi, grimmr, óþýðr ok fálátr. Gunnhildr, kona hans, var kvinna fegrst, vitr ok margkunnig, glaðmælt ok undirhyggjumaðr mikill ok in grim-masta.”*³⁶

(Eiríkr was a large and handsome man, strong and very courageous, a great warrior and winner of victories, but uncontrollable and cruel, unfriendly and quiet.

35 Jim Doran & Mike Palmer, “The EOS Project: Integrating Two Models of Palaeolithic Social Change” in *Artificial Societies: The Computer Simulation of Social Life*, ed. Nigel Gilbert & Rosaria Conte (London: UCL Press, 1995), 91–2.

36 Bjarni Aðalbjarnarson, *Heimskringla I*: 149.

His wife Gunnhildr was the most beautiful of women; wise and knowledgeable, she spoke kind words but always had ulterior motives and was the cruelest.)

The advantage here lies in the fact that the saga narratives frequently use these characteristics to present reasons for why characters act the way that they do – just as in the game. Their interactions with other characters, and whether an agent is more likely to instigate conflict or form an alliance to build his or her network further, are often rooted in these characteristics. And indeed, the Gunnhildr of the game starts with traits granting learning and knowledge modifiers, but also several penalizing traits including ‘Deceitful’ and ‘Cynical’, which enable violent choices in dealing with enemies and rivals, and give penalties to the opinion of those under her rule. Eiríkr has the traits to be a great warrior (e.g. the ‘Skilled Tactician’ background, which adds significantly to his martial ability), but simultaneously has the ‘Deceitful’ and ‘Envious’ traits, and starts the game with an almost maximized negative opinion of his brother Hákon, who usurped his throne with popular support. This all influences their choices, in the game as in the text. Overall, it is here that the ultimate conjunction between network analysis as method, grand strategy simulations as model, and Old Norse-Icelandic sagas as material, lies.

Methodology part I: Methods of organization

This theoretical foundation thus allows us to lay out the methodology for the simulation itself. In many ways, this follows the conventional network approach outlined by Brughmans et al, consisting of an abstraction of a past phenomenon as a network concept, and the use of that concept to gain back network data.³⁷ To organize the environment, and subsequently the experiment itself (before, during and after simulation), we can divide it into a series of categories, each following the previous category in natural order:

1-Reduction (of environment)

In order to satisfactorily utilize an environment to test hypotheses and track developments in a game environment, we must first of all be clear about which parts of said environment we will be following, tracking and modifying. I have here followed the rules for reduction as outlined by Breiteneker, Bicher and Wurzer:³⁸

37 Brughmans et al, *Network Perspectives on the Past*: 7–8.

38 Felix Breiteneker, Martin Bicher & Gabriel Wurzer, “Agent-Based Simulation in Archaeology: A Characterization” in *Agent-based Modeling and Simulation in Archaeology*, ed. Gabriel Wurzer, Kerstin Kowarik and Hans Reschreiter (Berlin/New York: Springer, 2015), 55.

- Distinction: Neglect those parts of reality which are not relevant for the purpose of the model
- Cutback: Neglect details that are irrelevant
- Decomposition: Decouple segments of an object which are not or weakly linked and treat them as own models
- Aggregation: Couple segments which act alike and treat them as one
- Abstraction: Create technological terms, classes and clusters in order to simplify the overall problem

While *Crusader Kings II* spans a map of the entirety of medieval Europe (and far beyond), there are far more details which are of no concern to the experiment than those that are. In terms of the first point, Distinction, there is nothing of relevance beyond the Scandinavian kingdoms and their immediate neighbors. In terms of Cutback, we will ignore anything not related to interpersonal connections between characters (such as health factors and personal activities).

2-Specification of assumptions

Having reduced the environment to an area of focus suitable for targeted study, it is time to outline what basic assumptions we hold as the foundation of the simulation, the rules of the game. These must be as accurate as possible both for the simulation (the modern game) and the source material (the medieval sagas). Here, for instance, we will rely on the following assumptions in order to study the development of medieval networks in *Crusader Kings*:

- 1) Individual agents will act according to their agenda of set goals, and their behavior will be based on the objective of achieving these set goals.
- 2) Individual agents behave according to principles of pragmatic, cynical *Realpolitik*, because the goal of the game is to expand the power base of one's family, whether through marriages, alliances, or conflict, often using family members as political currency.³⁹ This is highly similar to the political culture depicted in the kings' sagas, where scholars frequently discuss a 'political game.'⁴⁰
- 3) Individual agents will have certain pre-set relationships determining their starting interpersonal behavior. This includes pre-existing bonds of kinship, friendship and lordship, or simply interpersonal affinity. On the other hand, it also includes unfriendly relationships, from private dislike to public rivalries and outright conflict.
- 4) The relationships referred to in point 3 may occasionally override the basic principle of point 2 as, just as in any human context, emotional priorities may override calculated plans.

39 The cold and calculated pragmatism of kinship politics in *Crusader Kings* has also been briefly explored in Lucat & Haahr, *The Case of Crusader Kings II*: 264.

40 Bagge, *Society and Politics*: 82–7; Mindrebø, *The Bonds of Power*: 58.

- 5) Points 1–4 will lead characters to form various additional relationships with other agents, coalescing into broader social networks.

3-Testing/simulation

The third phase is that which focuses on the game simulation itself. Here it is important to run multiple phases of testing, including adaptation and revisions of the model (whether through modifications to the game, or the method of interpreting/viewing it). In this simulation phase, we essentially have two choices for how to proceed with our observations:

The first is to simply let the game run, which we can do in one of two ways. One is to choose a character outside the focus of the experiment (Scandinavia) to leave the option open for interaction with the central agents if necessary/desirable. The other is to utilize the game's developer console system to enable an observation mode, where the player can simply watch and observe the agents' movements without partaking in the game.

The second option involves direct player intervention, which we again can do in one of two ways. One is to control one or more characters who are directly involved as central agents, thus controlling certain components of the simulation in order to prod it in certain ways. We may, for instance, control a specific member of the networks in question, and select actions that fall as closely as possible in line with that character's actions as described in the saga narratives.⁴¹ This serves the purpose of enabling a close observation of the consequences after each such action, as well as systematizing the data, as will be done in the example below. The second way is again to use the console, which can be combined with playing as one or more particular agents, and add input to the game simulation along the way. With the console, we can for instance kill certain agents when they are supposed to die according to the source material, and otherwise ensure that certain actions and events do occur, such as specific bonds of alliance or marriage that are essential to observe further network-building (or -disintegrating) action, and again observe the changes in parameters after each such action.

If only observing, we cannot take the simulation very far before it becomes entirely different. If inserting ourselves, we can increase the correspondence of the simulation to source accounts, but at the expense of reducing the potential for emergent network-building behavior. The most fruitful way to harmonize this dichotomy is to only use player intervention in limited ways to facilitate network

41 The benefits of combining human and machine agents have been written about in Hiroshi Deguchi, "Agent-Based Modeling Meets Gaming Simulation: Perspective on Future Collaborations" in *Agent-Based Modeling Meets Gaming Simulation*, ed. Kiyoshi Arai, Hiroshi Deguchi & Hiroyuki Matsui (Tokyo: Springer, 2005), 8–13.

action and to create new conditions for observation rooted in the source material, and ensure the data is collected through structured observation after each instance or process of intervention. In the end, it is up to the individual researcher and simulation to determine the balance necessary for accumulating the greatest amount of useful data for the study.

Regardless, after running a set amount (10) of simulations of the same scenario with the same agents, we are left with a good amount of raw data to process.

4-Verification phase

Finally, verification against the source material is necessary after the simulation/experiment.⁴² In this study, this takes the form of returning to the source material with the raw data gained. If an agent takes a particular kind of action, this implies that they had little to no choice given the set parameters. It is possible the agent's situational parameters are indeed restrictive, or it is possible that the model (the game) is missing details which need to be inserted. In more cases, however, given the sheer volume of interpersonal actions available, agents will not simply take different actions in the game, but will take multiple different actions across the number of game simulations. This leads us to the second part of the methodology.

Methodology part II: The objective of deviation

One way of using games to study networks (and other forms of historical development) would be to simply follow the simulation to see how long it follows the original narrative in historiography for certain actors. In essence, this is not too far from what Henry Jenkins refers to as “enacting stories”.⁴³ In this case the playing of the game is restricted to maintaining an ‘accurate’ flow of historiographical narrative. This can be intellectually rewarding in itself in certain ways, for instance if studying the relative accuracy of strategy games as interpretations of historical material. One might further extend this by continuously restarting the game with more information, whether by modifying the code or simply choosing gameplay strategies better suited to the original source material development. However, the goal is not to have a model or set of rules that is completely accurate according to the source material, but rather a model that allows the observation of results within a certain range of accurate behaviors. If one ensures that the rule set of each character is one hundred percent accurate according to the source

42 Breitenecker, Bicher & Wurzer, *Agent-Based Simulation*: 54.

43 Henry Jenkins, “Game Design as Narrative Architecture” in *First Person: New Media as Story, Performance, and Game*, ed. Noah Wardrip-Fruin and Pat Harrigan (Cambridge MA: The MIT Press, 2004), 124–6.

material, the character's behavior simply becomes a product of the coding, allowing for no emergent behavior to be tracked and no new questions to be asked.⁴⁴ The real benefit of game-aided network simulation is thus to be found in the deviations from this track. The "emergent narrative" of a non-accurate simulation allows us to read the actions of agents and their networks in a new light.⁴⁵ If an Agent A married his children to those of a neighboring landowner B (Action A), his avatar in the game simulation may opt to declare war on one of these neighbors instead (Action B). This alternative action may be in pursuit of the same objective as the original action, or in pursuit of a different goal altogether. The point is that by deviating from the course taken by the original character in the source material, the game avatar has opened up a possibility for treatment and interpretation.

One method for interpreting deviations and gaining positive learning outcomes for the interpretation of the networks in the historiographical material would be as follows.

- 1) *Identifying priorities.* Why did the agent decide on Action B rather than the original Action A in Situation X? Examine the game parameters, including both personal and tactical considerations, to identify the actor's priorities.
- 2) *Comparison.* Compare to the source material and answer the following two questions:
 - a) Did the agent have the same identified priorities in the source material?
 - b) Did the agent have the means to take Action B in the source material?
- 3) Depending on the answers to these questions, we are left with one of two potential outcomes:
 - a) *Alternative.* If the answer to both questions is yes, we have identified an alternative action that the actor *could* have taken.
 - b) *Motivation.* If the answer to one or both questions is no, we have identified possible reasons why the actor made the choice to take the action which was actually taken in the source material.

Again, as with the method of simply following the character's actions until they do deviate, we may run these games multiple times, feeding information where desired to gain back additional data. Returning to the example of the landowners and their children, we may, for instance, set the targets' affinity for each other higher than their original number, increasing the chance of them opting for alliance rather than conflict.

44 Graham & Steiner, *TravellerSim*: 58.

45 Jenkins, *Game Design*: 128–9, uses 'emergent narrative' as another form of narrative architecture, emphasizing game simulations as environments where narratives emerge based on player and non-player character action.

Testing the model: *Hákonar saga góða*

Having outlined the methodological framework for the simulation and the study of it, it is time to put it into practice. In this case, we have already discussed and decided on the environment and our basic assumptions, so we will move straight from here to the testing phase. Due to the constraints of the article format, this will by necessity be a very basic initial example only intended to showcase the potential of the methodology rather than touching on every aspect, but the aim is to outline how some of the methods described may be applied as part of a qualitative network study.

In the recently added 936 selectable starting date of *Crusader Kings II*, we find an ideal point for utilizing the game as a reading tool with little to no initial modification. Much of the initial socio-political framework is constructed similarly to the descriptions in the kings' saga *Heimskringla*. In 936, both game and source material follow the sons of Haraldr Fairhair, their kinsmen, their allies and rivals, and those who have sworn allegiance to them or those they have sworn allegiance to. The network ties between them, and how these are built up and torn down, are at the heart of this example, and the close focus on one wider family group enables a tight focus while exploring the wider relational framework.⁴⁶

To comprehensively establish the context before attempting to simulate, three areas will have to be covered: the saga narrative up to c. 936; the socio-political game map in 936; and the saga descriptions of network developments thereafter. To begin with the first, *Heimskringla's* third saga, *Hákonar saga góða*, describes how, after the death of Haraldr Fairhair and succession of his eldest son Eiríkr, internal and external strife threatens to split the dynasty and the kingdom, until eventually Eiríkr is expelled, leaving the throne to his far younger brother Hákon, raised and educated as a Christian by King Æthelstan, the recent unifier of the Kingdom of England (r. 925–39).

The aristocratic landscape of political power and ruling networks is remarkably accurate, or at least as accurate as these can be within the confines of the game system. In Norway itself, the testimony of the saga texts is followed faithfully. A teenage Christian Hákon starts as king of a relatively unified kingdom, ruling the lands on the Norwegian west coast, where his power base is also located in the sagas.⁴⁷ The eastern parts of the country are, as explicitly described in *Heimskringla*, controlled by other powerful magnates and lesser kings of the same dynasty, powerful and relatively independent in their own right but under the nominal authority of Hákon.⁴⁸ This is reflected in what the game refers to

46 An approach inspired by Preiser-Kapeller, *The Ties that Do Not Bind*: 300.

47 Bjarni Aðalbjarnarson, *Heimskringla I*: 157.

48 *ibid*: 198.

as ‘kingdom laws’, where Hákon’s Norway has the minimum possible centralized royal control; essentially, those magnates who are subordinate to the king can do as they please. Finally, the one central magnate not related to the others, Sigurðr jarl of Hlaðir, rules Niðaróss as Hákon’s most powerful vassal, and perhaps strongest ally, despite the former being a Norse pagan and the latter a Christian convert.⁴⁹ While different religions would normally give an opinion penalty, the game has solved this by giving Sigurðr and Hákon the ‘Close friend’ trait, and Hákon the ‘Sympathy for pagan religions’ trait, enabling them to have an almost exclusively positive opinion of each other, which in practical game terms leads to an almost unassailable cooperation.⁵⁰

The remainder of the aristocratic networks beyond Norway are equally key to the context. The ousted Eiríkr blóðøx is in exile as a Viking lord in Caithness. He has bonds with the independent island kingdom of Norðreyjar (first and foremost consisting of Orkney and Shetland), ruled by Einarr jarl of Orkney. Again, this is mostly in accordance with what *Hákonar saga góða* has to say about Eiríkr’s activities in exile, where it is implied that he harried widely in Scotland and Northern England, relying on the friendly Norse islands, and the hospitality of their rulers, as a base.⁵¹ This is also the case for the other kings in question: Æthelstan is king of a more or less unified England, while Gormr the Old is in the same position in Denmark, with Haraldr ‘blátannr’ (Bluetooth) as his son and heir. Finally, Gunnhildr, Eiríkr’s wife, is presented as the daughter of King Gormr and sister of Haraldr Bluetooth. This is a clash with saga descriptions that give her a mystical origin story in the North of Norway, but also corresponds with Norwegian Latin sources, which have generally been considered more reliable in this case.⁵²

As such, without even pressing the button to start the simulation, the game already serves as a more or less adequate network visualization (albeit with limited information input), but the true value lies in its use as an interpretation tool for the weight and inevitability of what happens next, similar to how Haraldr Fairhair’s conquest was described at the beginning of the article. In the sagas, the following developments to the eyes of a historian of networks can be summed up in a few key points:

-
- 49 For details of Hákon’s network upon arrival in Norway as outlined in the sagas, see Bjarni Aðalbjarnarson, *Heimskringla I*: 150–1.
 - 50 For an assessment of why the historical Hákon may not have tried very hard to forcibly convert the Norwegians, see Claus Krag, “The Early Unification of Norway” in *The Cambridge History of Scandinavia, Vol. I: Prehistory to 1520*, ed. Knut Helle (Cambridge: Cambridge University Press, 2008), 190–1.
 - 51 Bjarni Aðalbjarnarson, *Heimskringla I*: 152.
 - 52 William Sayers, “Power, Magic and Sex: Queen Gunnhildr and the Icelanders”, *Scandinavian-Canadian Studies* 8 (1995): 60; Mindrebø, *The Bonds of Power*: 63–5.

- 1) Eiríkr, Einarr and Gormr all die in one way or another.
- 2) A daughter of Eiríkr and Gunnhildr is married to the new heir of Orkney for an alliance.⁵³
- 3) Hákon maintains positive and cooperative relationships with the Norwegian magnates. A Norwegian aristocratic network forms around him.
- 4) The Danish king and his allies enter conflict with the king of Norway and his allies.
- 5) Gunnhildr and her sons build close relationships with King Haraldr,⁵⁴ and build a network of their own under his protection, including the king himself and former connections in Orkney.
- 6) The two networks clash. The sons of Eiríkr and Gunnhildr invade Norway, thus both abiding by their alliance with King Haraldr and fulfilling their own claims on the Norwegian crown.
- 7) After multiple victories and successfully defending his kingdom, Hákon dies, leading to the crown passing to them, his enemies, as next in the logical dynastic line of succession.
- 8) The sons of Eiríkr and Gunnhildr maintain neutral or negative relationships with the Norwegian aristocracy, formally cordial and cooperative but masking resentment and tension, as the Norway that they rule remains dominated by Hákon's network.
- 9) Managing their kingdom through violent schemes and the assassination of major magnates, the sons of Eiríkr and Gunnhildr attempt to remove and replace all rivals.
- 10) Facing a rebellion of magnates, the sons of Eiríkr and Gunnhildr are defeated and dethroned by the heirs of their murdered rivals, and new leaders, first and foremost Hákon jarl Sigurðarson, take control of the kingdom through the old network of King Hákon.⁵⁵

I have deliberately excluded years and surplus detail, and even most individual names, avoiding as much chance as possible while accepting that wider kin groups may have the same motivations, even if the individual in question is removed (e.g. dies or is otherwise incapacitated, leaving their role for another network member). Due to the already considerable complexity of the individual relationships, it is practically impossible for the simulation to follow the source material to the letter, meaning that the goal is to track small-scale patterns in group/individual behavior as a cause-and-effect scheme. What we are interested

53 It has been a matter of debate whether this happens before or after Eiríkr's death; see for instance Margaret Cormack, "*Egils saga, Heimskringla and the Daughter of Eiríkr blóðøx*", *Alvíssmál* 10 (2008): 61–8.

54 The same Haraldr who is Gunnhildr's brother, if the game and the Latin sources are to be trusted; however, the sagas, despite their different explanation of her parentage, closely relate the building of these bonds.

55 This is a simplification, as the sons of Eiríkr only lose power after a period of on-and-off conflict and peace, cf. Krag, *Early Unification*: 190.

in is network-building and the establishment and breakdown of relationships and connections, according to predictable outcomes based on character motivation. The setup for the simulation is targeting relatively broad but focused sweeps, in order to also receive data in the form of relatively broad but focused sweeps. This, then, becomes our starting point for data collection, but other studies using the same methods will wish to set different parameters.

Simulation runs

Simulation part one: Observing succession

This walkthrough of simulated scenarios will center around the issue of Hákon's efforts to consolidate his power in the Norwegian kingdom and how he utilizes his connections and existing networks to accomplish this, as well as on Eiríkr and Gunnhildr and their sons, any network-building occurring on their behalf, and how they attempt to take control of the Norwegian kingdom (if able) through their own connections and efforts. I will recreate these dynamics in four successive ways. First, I run the simulation once on its own to understand the basic parameters we can expect to find. After selecting a more distant character, I utilize the game console to enter observation mode, completely distancing myself from the 'playing' of the game and allowing the simulated characters to act on their own behalf.

To begin with, the simulation follows the source material closely, indicating a good reflection of motivations and starting points, as discussed above. Eiríkr continues to attack Scottish land and occupies various provinces, but is wounded in battle. Meanwhile, Hákon remains more passive, but maintains universally good connections with the aristocratic structure of his kingdom.

Deviation first begins, however, in Denmark. King Gormr is still alive, but Haraldr Bluetooth has died of food poisoning, jeopardizing the chances of Danish support for the Eiríkr/Gunnhildr network. The Danish kingdom leaving the hands of the Knýtling dynasty is thus a risk, but instead Gormr has another son and subsequently dies, meaning Denmark passes into the hands of a two-year-old child. Much of the potential network structure the sons of Eiríkr eventually



Fig. 1 The opinion values of Hákon's core aristocratic network towards their king.

rely on in the source material is thus disrupted. Hákon faces a pagan revolt, but manages to successfully defeat it and convert his aristocratic supporters, including the jarl of Hlaðir, closely linking to his efforts at connection-building through religious appeasement in the sagas. No less importantly, he marries, and eventually has several sons. Through kinship, friendship, and tolerant relation-building, Hákon's ruling network is consolidated.

Many of the parameters required for the construction of the opposing network of the sons of Eiríkr do subsequently fall into place in the simulation. The tension between Denmark and Norway does begin, with the Danes claiming Southern parts of Norway, as in the source material. Eiríkr himself dies and leaves his claims to his son Haraldr and his (Danish) wife Gunnhildr as regent. Haraldr then comes of age, but loses his land and flees to Orkney, while Gunnhildr goes to Denmark to the court of her kinsmen.⁵⁶ However, Hákon is able to designate his kinsman and supporter Guðrøðr as heir, and eventually his own sons take up the role. All this results in a situation where Hákon's network in Norway retains its power structures, and all his aristocratic supporters retain their positions. Meanwhile Haraldr's and Gunnhildr's hopes fizzle out without them being able to build a network to challenge Hákon.

Overall, this initial simulation gives us key indications about the network structures if we accept its set parameters. It allows us to consider that the sons of Eiríkr are unable to challenge Hákon without the Danish-Orcadian connections at their backs, and that they are unable to put themselves in a position for Norwegian kingship without creating that clear challenge.

Simulation part two: Preventing succession

Second, I try to play through the simulation as King Hákon, giving myself the task of running the kingdom with as much stability as possible, while building his connections as far as possible to secure his rule. In each instance of this simulation, I am able to replicate the situation where Hákon is universally respected by the aristocratic network in control of Norway, and is able to avoid any internal strife through maintaining these connections. Abiding by the source material as closely as possible, I accept any proposals for feasts and the like in order to keep Hákon on positive terms with the pagan magnates under his rule, establishing further bonds. I also maintain his bonds with the Christian kings of England to ensure external support. After simulating the first few years ten times, an attempt from Eiríkr or his sons never occurs, as they have more than enough on their hands harrying in Scotland and Ireland. Whether before or after Eiríkr's death, a concrete connection with the kings of Denmark is never formed. The links from the source material are thus, one might argue, broken.

56 This is the default game option for widowed landless women.

Simulation run #	Average opinion of Hákon by direct subjects (942)	Conflict between Hákon and subjects (by 942 – Y/N)	Eiríkr alive (by 942 – Y/N)	Conflict with Eiríkr/other dynasty members (by 942 – Y/N)
1	80	No	Yes	No
2	67	No	Yes	No
3	83	No	No	No
4	72	No	No	No
5	82	No	Yes	No
6	72	No	Yes	No
7	73	No	Yes	No
8	81	No	Yes	No
9	68	No	No	No
10	79	No	Yes	No

Fig. 2 Results from the first set of simulations.

This all goes to reaffirm the point that Hákon's power base in Norway is presented in multiple ways as both strong and resilient, despite religious differences, and he is able to maintain connections with the Norwegian aristocratic fabric with relative ease, reflecting the improved standing he has (despite his religion) in comparison to the general dislike towards his brother Eiríkr, who failed to build these same connections. It reflects the description of him as widely liked and supported by the aristocracy.⁵⁷ As in the previous simulation example, it simultaneously shows that if we follow the model, a challenge against Hákon's Norwegian-centered aristocratic network can only be made with the construction and support of a similarly strong external network, with multiple individuals gathering around the aim to dethrone Hákon.

Simulation part three: Supporting succession

In a third sequence of simulations, I select the character of the later Danish king, Haraldr Bluetooth, to investigate the possibility of replicating the network forming against Hákon by orchestrating it as its most politically powerful member. As Haraldr, in each attempt I wait until I succeed to the Danish kingdom, use all available resources to build bonds across Denmark and stabilize the realm, then form a formal alliance with Eiríkr as my character's brother-in-law, providing him

57 See particularly Bjarni Aðalbjarnarson, *Heimskringla I*: 150–1.

Simulation run #	Gormr's death (year)	Alliance between Haraldr and Eiríkr (Y/N)	Hákon alive/ in power (by end of simulation – Y/N)	Conflict between Hákon and Danish forces (Y/N)	Attempted claim on Norway by Eiríkr (Y/N)
1	940	Yes	Yes	Yes	No
2	940	Yes	Yes	No	No
3	941	Yes	Yes	Yes	No
4	944	No	Yes	No	No
5	937	Yes	Yes	Yes	No
6	937	Yes	Yes	Yes	No
7	940	Yes	Yes	Yes	No
8	944	No	Yes	No	No
9	941	Yes	Yes	Yes	No
10	940	Yes	Yes	No	No

Fig. 3 Results from the second set of simulations.

with land in my kingdom if necessary. This is enabled by the characters' kinship by affinity, and effectively means that Eiríkr could count on my military assistance were he to press his claim on the Norwegian kingdom. Across multiple successive attempted simulations, he does not do this. That the game Eiríkr, like the saga Eiríkr, opts to never return to Norway, but instead fights and raids in the British Isles until his death, is telling. While there is no guarantee that the game has been able to completely predict Eiríkr's motivations, it seems to successfully reflect the saga ideas that it is not Eiríkr, but perhaps Gunnhildr, who is the mastermind behind their sons' vying for Norwegian kingship.⁵⁸

Nevertheless, the data provided is helpful in assessing the situation. After ten simulations (two, simulation #4 and #8, where Eiríkr died before Gormr and the alliance was never created), there is no indication of Eiríkr pressing his strong claim, even when Hákon is embroiled in other conflicts, and members of the Danish aristocracy are raiding his land. Given that the goal here was simply to facilitate the challenge missing above, rather than to forcibly create it through player intervention, we end the simulation here and progress to the last stage.

⁵⁸ For a survey of Gunnhildr's role in this network-building, see Mindrebø, *The Bonds of Power*: 61–4.

Simulation part four: Forcing succession

The last sequence of simulations is an attempt to observe what happens if we ensure both Hákon and Eiríkr die, and a young Haraldr Eiríksson inherits the Norwegian kingdom with Gunnhildr as regent, essentially allowing us to start at point 7 in the narrative sequence above. The objective of this final segment is to see whether they can indeed stabilize their reign through connection-building and the removal of threatening opponents as is the case in the source material or, as with the other sets of simulations, to see what transpires differently.

We start the same way the simulation started initially, then intervene with the console to artificially remove both Hákon and Eiríkr. While this puts Haraldr in a position of Norwegian kingship earlier than in the source material, it carries the advantage of a relatively clean slate, and a state in which Haraldr and Gunnhildr, as in the sagas, gain control overnight of a kingdom which is still dominated by the supporters of Hákon. In this scenario, I am immediately able to replicate certain key conditions. Haraldr becomes king, Gunnhildr becomes his regent and power behind the throne, and an alliance is formed with Denmark to back up Haraldr's tenuous rule. Further, while the entire aristocratic network around Hákon has a lower opinion of Haraldr, he is not disliked, meaning the game is able to accurately reflect the initial situation of continuity where, when Hákon dies childless, the aristocracy quickly accepts Haraldr as heir and the initial period has cordial relations and peace agreements where the new ruling family promises to preserve Hákon's ruling structure.⁵⁹ These connections are easily retained, and even across multiple starts with the same parameters, the opinion values remain at a similar level.

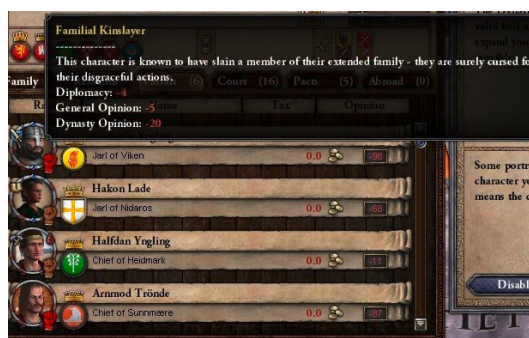
For the final aspect of the simulation, I keep all instances running until Haraldr comes of age and can act entirely of his own accord, in order to be able to simulate and test the cause-and-effect relation of steps 9 and 10 in the historiographical sequence above. To follow the sagas as closely as possible, I have Haraldr and Gunnhildr act as power-grabbing tyrants, attempting to remove all members of Hákon's network and install their own allies. At first this is successful. Killing Sigurðr jarl quietly and in secret, as seen in three of the simulation runs, only makes his son and heir dislike me, but no further action is taken. Killing King Tryggvi very openly then makes everyone see me as a tyrant, and I receive the 'Kinslayer' trait (see figure 5). This leads to intense dislike against Haraldr by all surviving aristocrats, there is a peasant revolt against him, and he survives an assassination attempt. In four simulation runs, where Haraldr faces particularly low opinion values throughout, open aristocratic revolts begin to end his rule.

59 Bjarni Aðalbjarnarson, *Heimskringla I*: 198–200.

Simulation run #	Average opinion value of Haraldr by direct aristocratic subjects (upon succession)	Killing of Sigurðr jarl – plot revealed (Y/N)	Killing of King Tryggvi – provokes aristocratic revolt (Y/N)	Average opinion value of Haraldr by direct aristocratic subjects (after killing of Tryggvi)	Imprisonment of Hákon jarl – provokes aristocratic revolt (Y/N)
1	29	No	No	–30	Yes
2	19	Yes	No	–66	Yes
3	8	Yes	Yes	–70	N/A
4	20	Yes	No	–69	Yes
5	31	No	No	–34	Yes
6	15	Yes	Yes	–67	N/A
7	19	No	No	–9	Yes
8	31	Yes	No	–52	Yes
9	16	Yes	Yes	–67	N/A
10	16	Yes	Yes	–70	N/A

Fig. 4 Results from the final set of simulations.

Fig. 5 The ‘Kinslayer’ trait and public opinion (from simulation #2 in the table above).



However, in six out of ten runs, it is only when I have him attempt to imprison Hákon jarl, son of Sigurðr jarl, and this action fails, that he faces a full rebellion. Due to the low opinion values of most of the Norwegian aristocracy against their king, in all these runs the entire country, aside from Haraldr’s own lands, join in the uprising, rallying around Hákon jarl as the rebellious network’s leading figure, taking us to the end of step 10 if we fall in line with saga narratives.

Verification, development & conclusion

Moving forward, the subsequent verification phase allows us to interpret the data collected. Deviations from the source material allow for more in-depth treatment of specific processes. For example, that the eventual success of the sons of Eiríkr is not easily replicated in the simulation can usefully inform readings of the source narrative. Deviation allows us to see the importance of the actions taken, and what they were working to accomplish or prevent. When the simulation shows that the sons of Eiríkr are unable to break Hákon’s hold over the Norwegian aristocracy across multiple simulations from different starting points, it indicates the relative success of Hákon’s network-building and religious appeasement policies, and that much of the opposing network’s plan rests on their ability to build a strong connection with the king of Denmark. Simultaneously, it suggests that Eiríkr’s death is a necessary component for the network to be constructed, perhaps because it allows the Danish Knýtling dynasty, with the link between Gunnhildr and Haraldr Bluetooth at the forefront, to align with young and more controllable Norwegian pretenders.⁶⁰ In essence, the deviation of the simulation from the narrative found in the source material allows us to make observations about the weight of certain interpersonal relationships and their

⁶⁰ Indeed, when Gunnhildr brings her sons to Denmark in the sagas, her eldest son Haraldr enters the fosterage and military service of his uncle and namesake the Danish king, the former thus for all intents and purposes becoming the latter’s subordinate supporter; see Bjarni Aðalbjarnarson, *Heimskringla I*: 162.

importance in maintaining wider power structures, going a long way towards reconstructing Sindbæk's "black box", the broken links of the network.⁶¹ The level of dependence on Danish connections, the interrogation of whether the sons of Eiríkr have easier access to Norwegian power structures than their father due to these connections and their young age, and the implications that these have for saga representations of the ruling networks of early Scandinavia, are questions which have not been asked in previous scholarship, where the focus has simply been on the delay to any challenge to Hákon's power being due to the necessity of waiting for these sons to mature, with the Danish connection typically taken for granted due to shared kinship.⁶² The simulation here highlights opportunities for further investigation of the network dynamics in the source material.

Furthermore, the successful treatment and interpretation of a deviation from the material is not the end of the process. We are not interested in what might have happened, but instead in the alternatives open to the actors at hand, as well as the alternatives which challenge the conclusions we may have drawn based on the source material alone. What options, one might ask, are open to the sons of Eiríkr beyond approaching the king of Denmark and building a network with eyes on reclaiming the Norwegian kingdom? Based on the simulations above, it would seem the answer may indeed be very little. Without Orcadian and later Danish support, the sons of Eiríkr fade into obscurity at one point or another, across all attempted simulations, eventually succumbing to English, Scottish and Irish efforts to expel Norse pagan conquerors from the British Isles. This is also highly reflective of the family's situation upon Eiríkr's death, where they flee Britain to avoid persecution.

This finally takes us to the road ahead, and how to put this methodology into further practice. The final advantage of the simulation as outlined is that it allows us to see the flaws which require modification for better academic use. For instance, the simulation rooted in *Hákonar saga góða* is in many ways remarkably accurate, but (as would be the case with many similar medieval sources) it only contains room for the principal agents: the king, his close (friendly and hostile) family members, and other nationally powerful aristocrats. The networks of the kings' sagas are a diverse mix, meaning we end up with what Preiser-Kapeller refers to as "*a dense core of well-connected nodes and a periphery of less well connected ones*"; however, the periphery remains important and is mostly missing from the game.⁶³ Given time to implement a complex society in the simulation, going as far down the social ladder as the source material allows, one could create a valuable tool for the tracking and observation of interpersonal connections, allowing us to use the game for micro-level network analysis that tracks all the

61 Sindbæk, *Broken Links and Black Boxes*: 89

62 Cormack, *The Daughter of Eiríkr blóðøx*: 63–4; Krag, *Early Unification*: 189–90.

63 Preiser-Kapeller, *The Ties that Do Not Bind*: 307

characters in a given text, or set of texts, across unlimited simulation runs. The same goes for other intricacies, such as the laws and customs of royal and aristocratic succession. Due to its efforts to standardize an algorithm of automated succession procedures across the game world, *Crusader Kings* fails to recognize the loose and relatively unorganized Norwegian succession in the sagas where each king's son often had a claim to power, and where pressing the claim politically or militarily would be the most logical pathway to kingship. As such, the automated transition of kingship from one character to another is another issue which should be dealt with when attempting to modify the game into a model that more accurately reflects the source situation, and succession modification has already been successfully attempted in the non-academic modding community.

As was mentioned initially, this experiment has, for the sake of introductions, started with *the game as is* as its entry point to the network simulation practice. Longer-term and more extensive follow-up work must, by necessity, start with the textual material, build a model within the game system from the textual evidence, and simulate from there, ideally with a continual cycle of updating the model after each simulation. This can take root in saga texts, as this article has, or the other texts mentioned above, but it would also be useful in more high medieval feudal contexts, as the *Crusader Kings* is very similar to, for instance, the kind of medieval German aristocratic group bonds analyzed in the work of Gerd Althoff. Nevertheless, this experiment has both laid the groundwork for such development, and clearly shown that there is merit to the conceptualization of games as a software tool for historical network study.

Bibliography

Primary sources

Bjarni Aðalbjarnarson. *Heimskringla I*. Reykjavik: Hið íslenska fornritafélag, 2002.

Scholarly works

Althoff, Gerd. *Family, Friends and Followers: Political and Social Bonds in Early Medieval Europe*. Cambridge: CUP, 2004.

Arai, Kiyoshi, Hiroshi Deguchi & Hiroyuki Matsui (ed.). *Agent-Based Modeling Meets Gaming Simulation*. Tokyo: Springer, 2005.

Bagge, Sverre. *Society and politics in Snorri Sturluson's Heimskringla*. Berkeley: University of California Press, 1991.

Breitenecker, Felix, Martin Bicher & Gabriel Wurzer. "Agent-Based Simulation in Archaeology: A Characterization." In *Agent-based Modeling and Simulation in Archaeology*, edited by Gabriel Wurzer, Kerstin Kowarik and Hans Reschreiter, 53–76. Berlin/New York: Springer, 2015.

- Brughmans, Tom. "Connecting the Dots: Towards Archaeological Network Analysis." *Oxford Journal of Archaeology* 29, no. 3 (2010): 277–303.
- Brughmans, Tom, Anna Collar and Fiona Coward, "Network Perspectives on the Past: Tackling the Challenges." In *The Connected Past: Challenges to Network Studies in Archaeology and History*, edited by Tom Brughmans, Anna Collar & Fiona Coward, 3–19. Oxford: OUP, 2016.
- Cegielski, Wendy H. & J. Daniel Rogers. "Rethinking the Role of Agent-Based Modeling in Archaeology." *Journal of Anthropological Archaeology* 41 (2016): 283–98.
- Cormack, Margaret. "Egils saga, Heimskringla and the Daughter of Eiríkr blóðøx." *Alvíssmál* 10 (2001): 61–8.
- Deguchi, Hiroshi. "Agent-Based Modeling Meets Gaming Simulation: Perspective on Future Collaborations." In *Agent-Based Modeling Meets Gaming Simulation*, edited by Kiyoshi Arai, Hiroshi Deguchi & Hiroyuki Matsui, 1–14. Tokyo: Springer, 2005.
- Doran, Jim & Mike Palmer. "The EOS Project: Integrating Two Models of Palaeolithic Social Change." In *Artificial Societies: The Computer Simulation of Social Life*, edited by Nigel Gilbert & Rosaria Conte, 103–25. London: UCL Press, 1995.
- Ferber, Jacques. *Multi-Agent Systems: An Introduction to Distributed Artificial Intelligence*. Harlow: Addison-Wesley, 1999.
- Graham, Shawn & James Steiner. "TravellerSim: Growing Settlement Structures and Territories with Agent-Based Modeling." In *Digital Discovery: Exploring New Frontiers in Human Heritage. CAA 2006. Computer Applications and Quantitative Methods in Archaeology. Proceedings of the 34th Conference, Fargo, United States, April 2006*, edited by Jeffrey T. Clark and Emily M. Hagemester, 57–67. Budapest: Archaeolingua, 2008.
- Jenkins, Henry. "Game Design as Narrative Architecture." In *First Person: New Media as Story, Performance, and Game*, edited by Noah Wardrip-Fruin and Pat Harrigan, 118–130. Cambridge MA: The MIT Press, 2004.
- Kilduff, Martin & Wenpin Tsai. *Social Networks and Organizations*. London: Sage, 2003.
- Krag, Claus. "The Early Unification of Norway." In *The Cambridge History of Scandinavia, Vol. I: Prehistory to 1520*, edited by Knut Helle, 184–201. Cambridge: CUP, 2008.
- Lake, Mark W. "Explaining the Past with ABM: On Modelling Philosophy." In *Agent-based Modeling and Simulation in Archaeology*, edited by Gabriel Wurzer, Kerstin Kowarik and Hans Reschreiter, 3–36. Berlin/New York: Springer, 2015.
- Lucat, Bertrand & Mads Haahr. "What Makes a Successful Emergent Narrative: The Case of *Crusader Kings II*." In *Interactive Storytelling: 8th International Conference on Interactive Digital Storytelling, ICIDS 2015, Copenhagen, Denmark, November 30–December 4, 2015, Proceedings*, edited by Henrik Schoenau-Fog, Luis Emilio Bruni, Sandy Louchart & Sarune Baceviciute, 259–266. Berlin: Springer, 2015.

- MacCarron, Pádraig & Ralph Kenna. "Network Analysis of the *Íslendinga sögur* – The Sagas of Icelanders." *European Physical Journal B* 86, no. 10 (2013): 1–9. <https://arxiv.org/abs/1309.6134>.
- Mac Carron, Pádraig & Ralph Kenna. "Viking sagas: Six degrees of Icelandic separation – Social networks from the Viking era." *Significance* 10, no. 6 (2013): 12–17. <https://doi.org/10.1111/j.1740-9713.2013.00704.x>.
- Mindrebø, Markus E. *The Bonds of Power: Women's Political Participation in the Sagas of Norwegian Kings, c. 950–1200*. London: Unpublished PhD thesis, 2021.
- Morrissey, Robert M. "Archives of Connection: "Whole Network" Analysis and Social History." *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 48, no. 2 (2015): 67–79. <https://doi.org/10.1080/01615440.2014.962208>.
- Preiser-Kapeller, Johannes. "The Ties that Do Not Bind Group formation, polarization and conflict within networks of political elites in the medieval Roman Empire." *Journal of Historical Network Research* 4 (2020): 298–324.
- Sayers, William. "Power, Magic and Sex: Queen Gunnhildr and the Icelanders." *Scandinavian-Canadian Studies* 8 (1995): 57–77.
- Schut, Kevin. "Strategic Simulations and Our Past: The Bias of Computer Games in the Presentation of History." *Games and Culture* 2, no. 3 (2007): 213–235. <https://doi.org/10.1177/1555412007306202>.
- Shannon, Robert E. *Systems Simulation: The Art and Science*. Englewood Cliffs: Prentice-Hall, 1975.
- Shen, Cuihua, Peter Monge & Dmitri Williams, "Virtual Brokerage and Closure: Network Structure and Social Capital in a Massively Multiplayer Online Game." *Communication Research* 41, no. 4 (2014): 459–80.
- Sindbæk, Søren M. "The Small World of the Vikings: Networks in Early Medieval Communication and Exchange." *Norwegian Archaeological Review*, 40, no. 1 (2007): 59–74.
- Sindbæk, Søren M. "Broken Links and Black Boxes: Material Affiliations and Contextual Network Synthesis in the Viking World." In *Network Analysis in Archaeology: New Approaches to Regional Interaction*, edited by Carl Knappett, 71–94. Oxford: OUP, 2013.
- Sverrir Jakobsson. "The Early Kings of Norway, the Issue of Agnatic Succession, and the Settlement of Iceland." *Viator* 47, no. 3 (2016): 171–88. <https://doi.org/10.1484/J.VIATOR.5.112357>.
- Watts, Duncan J. "Networks, Dynamics, and the Small-World Phenomenon." *American Journal of Sociology* 105, no. 2 (1999): 493–527.