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Empirical Aspects of a Mixed Method Approach to Economic Network Analysis[1]

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Abstract

We discuss the interactions among the various phases of network research design in the context of our current work using Mixed Methods and SNA on networks and rural economic development. We claim that there are very intricate inter-dependencies among the various phases of network research design - from theory and formulation of research questions right through to modes of analysis and interpretation. Through examples drawn from our work we illustrate how choices about methods for Sampling and Data Collection are influenced by these interdependencies.

Introduction

Most discourses on Research Design identify a number of different phases, each of which presents the researcher with distinct choices: paradigmatic stance; use of theory; development and operationalisation of research questions; Methodology - sampling, data collection, and analysis; and interpretation. In Mixed Method research designs, the range of choices at each of these phases is very wide, and much attention has been given to identifying frameworks and guidelines for making suitable and compatible choices among the options. Good surveys are given in a number of recent texts and collections (Bergman 2008; Plano Clark & Creswell 2008a; Creswell 2009; Teddlie & Tashakkori 2009b). While the focus of this paper is on methods of sampling and data collection for network analysis within a mixed method design, we contend that the appropriateness and validity of the methods chosen in those phases depend in a complex way on the choices made in all of the other phases and on the overall "theoretical drive" of the project (J. M. Morse 2002, pp.190-194; J. M. [1] Morse et al. 2006).

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Consequently we discuss each of those phases briefly as they were applied in our study, and show in particular how they influenced our approach to sampling and data collection. Fieldwork for the study was carried out over the past two years, and is now largely complete. It involved face-to-face interviews with some 60 subjects, resulting in two networks, roughly evenly divided, and comprising some 550 actors in total. Analysis and interpretation of the datasets is continuing.

Paradigms

While there has been much controversy about questions of ontology, epistemology and methodology, it now seems generally accepted that the particular set of viewpoints, commonly termed the "paradigm", that a researcher chooses to adopt is "axiomatic"(Guba 1990:81): "they cannot be proven or dis-proven in any foundational sense" (Guba 1990:18). Our own viewpoint is best described as "post-postivism", characterized (albeit critically) by Guba as composed of

Ontology	*Critical Realism* – there is a "real" reality, but it is only imperfectly and probabilistically apprehensible.
Epistemology	*Modified Dualist/Objectivist* – ""findings" emerge from the interaction of inquirer and inquired into, so objectivity is a "regulatory ideal" - in particular research can rely on "critical tradition" (i.e. pre-existing literature in the field of inquiry) and on peer review.
Methodology	*Critical Multiplism* – favours inquiry in more natural settings, using more qualitative methods, etc. The goal is to rebalance between discovery (induction) and verification (deduction)[2].

Table 1 The "Post-Positivist" Paradigm - (Guba 1990, p.20; Lincoln & Guba 2005, p.193).

This paradigm influenced our approach to network research in a variety of ways. First, we view networks as "socially constructed" through the agency of the actors. We do not take a view in which agency is the sole or dominant source of explanation however, believing that actors are constrained and their agency is shaped by the network structure in which they are embedded. Second, we believe that the networks we study are "imperfectly apprehensible" in many ways – being subject to incomplete definition in terms of actors and relational types as well as to temporal shifts and evolution. Third, we favour the use of Mixed Methods – combining Social Network Analysis (quantitative) with Thematic Analysis (qualitative). In keeping with the post-positivist paradigm, we seek to develop not only traditional "scientific" descriptions of our findings, that is "linguistic, mathematical and graphic descriptions which

[2] (Denzin 1977) called this "elaborated triangulation".

can be generalised" (Thomas & Brubaker 2000, p.16) but also description of individual agency and meaning.

Finally, our approach integrates deductive ("testing theory") and inductive ("generating theory") approaches in an iterative fashion. Starting from an initial theory or conceptual framework that was derived from an established body of literature (described below), we proceeded in successive and iterative stages: first deductive, testing theory and identifying gaps or contradictions; and then inductive, developing and refining theory based on the observed data. The output of the inductive stage is a "new" theory, which may in turn be subject to another cycle of deductive/inductive inquiry. There has been some controversy about whether deductive and inductive approaches can be combined in the "logic of enquiry" (Brannen 1992, Brannen 2005) or "theoretical drive" (J. M. Morse 2002, p.190; J. M. [1] Morse et al. 2006) of a study, but most recent writers approve of doing so (Greene 2007, p.118; Brannen 2005, p.14).

In summary, beginning from a post-positivist paradigm influenced the phases of our research design in many ways. For example:

- we relied on "critical tradition" to derive a Conceptual Framework (described below) from existing literature (itself the outcome of prior empirical studies)
- Data Collection followed a "social constructivist" path, using Expanding Selection and realist boundary specification
- we chose to use a Mixed Method design in order to capture aspects of both structure and agency
- we designed our Research Instruments to concurrently collect Qualitative and Quantitative data through one-hour face-to-face interviews
- in the name generators for relational data collection we sought subjective perspectives on relations, attributes, and weights

From Theory to Conceptual Framework

The role of the "Knowledge Economy" has spurred much debate in research and policy circles over the past decade or more. Especially in rural and remote areas such businesses, connected to the global economy through ICT, have been proposed as a viable alternative to traditional, agriculture or resource-based, industries. Much of this debate has, at least implicitly, involved the notion of networks. We made the network the explicit centre of our research and analysis by devising a comparative structural analysis of two contrasting business networks. The networks are located in the type of area that has been seen as most likely to benefit from the growth of ICT-enabled knowledge work. Our research themes consequently encompass notions such as the "local economy", "global-local interaction", "knowledge" and "communication".

Current research on this topic is multi-disciplinary, although centred most actively in Economic Geography. Researchers in this field have focused on the concept of "proximity" in its spatial, social, cognitive and organizational forms (Boschma 2005; A. Lorentzen 2005;

Anne Lorentzen 2009; Lagendijk & Anne Lorentzen 2007). The roots of much of this discussion lie in research, dating back to (Marshall 1890), on "Industrial Districts" or "clusters" e.g. (G. Becattini 1990; A. Malmberg & P. Maskell 1997; Bathelt 2008; Giacomo Becattini et al. 2010; Porter 2003). Research on ICT's, knowledge and innovation has identified "knowledge typologies" as a key factor in forms of economic activity and development, contrasting tacit with codified knowledge and innovative with incremental learning (Bathelt et al. 2004; Gertler 2003).

We drew on this body of theory to develop a conceptual framework comprising a number of broad categories. First is the "dialectic" between the processes of economic dispersal and agglomeration. Second are notions of *mutual dependence* common in Industrial District theory. The concept of *knowledge* also incorporates an internal dynamic between *communication* and *formation*. Knowledge that is unarticulable or embodied in an individual – tacit knowledge (Polanyi 1966) - has little economic effect, and thus *codification* is a prerequisite for its widespread communication and diffusion (Cowan & Foray 1997; Cowan et al. 2000). Moreover, in general, new knowledge is formed predominantly through various processes of synthesis, innovation and *learning*, all of which have a social context (Lave & Wenger 1991; Lundvall & Johnson 1994). Finally, in a reflexive turn, new forms of ICT-mediated communication are seen as changing the "geography" of such learning processes and of the spatial organisation of economic activity. (Leamer & Storper 2001).

We approach our study of "local economies" through the (simplifying) abstraction of inter-firm economic networks. Such networks are multiplex, comprised of many individual types of relations, and are themselves embedded in networks formed by more "social" relations, such as affective or kinship relations[3].

The literature on industrial districts has derived through empirical and theoretical studies a set of five relational types: Supplier, Customer, Service, Ally and Competitor (Richardson 1972; Asheim 2000) and it was for these five relations that we collected data and subsequently derived network representations.

Our conceptual framework influenced succeeding aspects of our research design in many ways. For example, it:

- provided "axes" for initial purposive sampling
- suggested themes for qualitative research instruments and for data-collection
- defined the sets of actors and relations considered in SNA
- suggested the focus of name-generators and name-interpreters in SNA data-collection

[3] Qualitative inquiry revealed traces of the embedding of economic action and network formation in this "network of networks" (Wellman 1997, p.20). For example name interpreters that asked how relationships were first established often were answered in terms of social connections such as kinship, religion, or participation in education, community or leisure activities.

- was used to define an initial set of codes for QUAL analysis
- was the basis for an initial set of "hypotheses" that were used to guide deductive analysis and interpretation.

Methodology

Network Sampling

Our goal was to find empirical samples of networks that are "representative" of "local economies", because at the interpretation phase we want to be able to argue back to theory and as necessary construct new explanatory theory and constructs.

Thus we sampled at multiple levels:

- *Region*: a geographically bounded area, seen as comprising one or more exchange economies
- *Network*: a set of firms operating in a distinct sector of economic activity, and a set of relationships between them
- *Actor*: the actors involved in such a network

Following a typology of sampling applied to Mixed Methods (Teddlie & Yu 2007) we identify our approach as "purposive" and "comparable". It is "purposive" (rather than "probabilistic") in that the sample is "based on specific purposes associated with answering a research study's questions" (Teddlie & Yu 2007, p.77), and "comparable" because we are "sampling to achieve comparability across different types of cases on a *dimension of interest*" (Teddlie and Yu 2007:80). Finally we note that our sampling is "multilevel", described by Teddlie & Yu as "very common in research … in which different units of analysis are 'nested within one another' [to answer] questions related to two or more levels or units of analysis" (Teddlie and Yu 2007:93).

The region chosen was West Cork, in the southwest of Ireland. This area remains largely rural, in places very sparsely populated, with significant economic reliance on agriculture, fisheries and tourism. Although hardly "remote" on a global scale, distance is still a factor – the driving time from Cork City to the western edge of the region is the same as the driving time from Dublin to Cork and nearly twice as long as the flying time from London to Cork. There is a long coastline, divided into several peninsulas, mountains, forests and lakes. While economically challenging, these factors also make it a "high-amenity" region, which has had much in-migration of skilled people over a period of some 50 years. In-migration and local resources have combined in a nationally significant specialist or artisan food sector, with well-developed support structures including formal business networks, marketing and branding (Sage 2003; Crowley 2004). In more recent years there has been a new wave of incomers involved in knowledge industries such as software development and services, and digital media (music, film, design).

We chose those two business sectors – specialty foods, and digital industries, in order to bring out differences related to specific aspects of the conceptual framework: knowledge-content, sources of input factors, reliance on tacit and codified knowledge, and adaptability to

the use of ICT in the various stages of production and marketing. For each business sector we then constructed (as detailed below) a network of actors doing business in that sector.

The actors were sampled using "Expanding Selection" (Doreian & Woodard 1992), an adaptation of "snowball sampling" (Goodman 1961) to SNA. We began from an initial "seed" list and followed the links created by the reported network relations. To select the seeds we again used "purposive" sampling. This selection was based both on theory and on detailed local knowledge gained through a combination of prior knowledge, expert advice and extensive observation. In contrast to some other studies we didn't necessarily seek out the "most influential" or "best connected" actors. We supposed that the network of interest might be composed of several components and we tried to distribute the set of initial subjects across likely components. Our assessment of "likelihood" was determined principally by theory (e.g. "service" versus "product") and by preliminary interviews with key informants. We tried to find initial actors who might exhibit distinct "patterns" of connection. Thus we hoped to capture a representative extent of the network (and thus of the "local economy") rather than simply its "main component".

In the case of the "food" network we selected 5 seeds based on a distribution over a cross-categorization of firm size and economic sub-sector (with 8 cells in total), as shown in Table 2 below.

	Meat/Fish	**Dairy**	**Horticulture**	**Baked/Processed**
Small	WCSF003	-	WCSF004	WCSF002
Medium	WCSF001	WCSF005	-	-

Table 2 Seeds for the "food" network

We note that these categories are associated with different levels of materiality of product (transport conditions and costs, shelf-life, market location) and scales of production and investment, so connecting back to theory.

For the "digital" network we used a different categorization because, while distinct sub-sectors exist - related to market or to technology base - there is no "digital cluster" in any meaningful sense in the area and "digital" actors do not distinguish themselves from one another on that basis. Instead we made a cross-categorization based (as above) on firm size, on product versus service, and on customer-focus: local or global. The distribution of the 6 seeds across those categories is shown in Table 3[4]. Note again that this connects to theory: for example, software products necessarily embody codified knowledge, while services are more "tacit".

[4] While the cross-categorisation here has 8 cells, the upper-left corner, digital products with a local market-focus, is unlikely to arise in practice.

		Local Focus	Global Focus
Product	**Small**	-	WCPS001
	Medium	-	WCPS004
Service	**Small**	WCPS002	WCPS073
	Medium	WCPS005	WCPS072

Table 3 Seeds for "digital" network

Another important reason for our choice of Expanding Selection is connected to our approach to "Boundary Specification". An early paper on this topic by Laumann et al distinguished between a *realist* specification in which the researcher accepts the network boundaries experienced by the actors in the network, and a *nominalist* specification in which the closure of the network is imposed by the researcher's theoretical framework (Laumann, Marsden, and Prensky 1983).

There is a sense in which our study combined the two forms of specification: at the higher levels we adopted a *nominalist* specification, i.e. a geographic area and a pre-determined economic sector. Subsequently we followed links reported as "most important" by the actors, i.e. a *realist* specification. But we terminated our traversal of the emerging network when we encountered an actor who was located outside the geographic area or the economic sector, giving a pair of *stopping rules* to enable network closure. Encountering an "out-of-area" or "out-of-sector" actor determined that we had reached the "edge" of the network**,** and we did not record the relations originating onwards from that actor. It is significant also that the "theory" (the "industrial districts" model of those relations which influence action) against which the study was conceived and the methodology devised started to "give out" at those points – i.e. its scope of applicability had limits[5].

Rather than pre-determining the number of waves, or requiring a minimum number of connections for an actor to qualify for inclusion, we continued iterations of expanding selection until we had exhausted the list of new contacts who satisfied the stopping rules, i.e. until we reached (empirical) "saturation".

[5] I conducted a number of interviews with multiply-referenced actors whose matching of network membership criteria was arguable (e.g. a little distance outside the geography or the sector). I noted marked differences in their local network "structure", with very different patterns of connections and consequently of strategy and orientation. For example, restaurants rarely identified "top customers" and so had very different market-orientation than food-production businesses; commodity primary producers tended to have very narrow supply chains – often only one supplier and few outlets – and so described (i.e. in the QUAL data) internal cost-control as their generator of competitiveness rather than innovation or market extension.

In justification of our stopping rules, we note that two of the central motivations for using network analysis in our study were that it allowed us to capture local-global dynamics and to identify sub-structural characteristics of a rural economy in a way that aggregative quantitative methods cannot readily do. In further justification, we also point to Laumann's description of a "partial system fallacy" - for example "transfer of money" as a relation within a geographically-bounded network (Laumann et al. 1983:76). He noted that in such a case, if a strictly nominalist (geographically-defined) boundary were used, "many of the central organizations in the total network of money flows would be excluded". This is strongly similar to our motivations for following business connections – to a limited extent - "out of the area".

During the Data Collection phase and again at its conclusion, we considered the question of whether the sampling resulted in the collection of "representative" data. We used a variety of heuristics[6] to assess this:

i. cross-checking with rosters of formal business networks in the area, such as Fuchsia Brands for the food network, and it@cork for the digital network (O'Reilly 2001; O'Reilly et al. 2007; West Cork Development Partnership n.d.). In the food case, for example we collected data from 5 of the 15 members of Fuchsia Brands who might ab-initio meet our criteria for inclusion, or 30% of that group. We note that this network incorporates a branding scheme and requires a membership fee and so may favour larger enterprises

ii. cross-checking with "experts" in research and in local development agencies

iii. cross-checks (often informal) with sampled actors – "have you met X?' or "you should talk to Y"

It is clear (based on the numbers above) that our sampling was not exhaustive. But, while the question of external validity is not a decidable one – "[it] cannot be tested, by definition. It rests at the level of assumption" (Gerring 2011, p.83) – we are naturally inclined to ask whether our design is better or worse than alternatives – for example a stratified sample of a (nominally) complete network such as Fuchsia Brands, with data collected through a survey with a typical survey response rate?

As mentioned above, such an approach would have its own bias – for example, towards larger and possibly more "conventional" food producers. There is also the issue of "hidden" populations: some of the smaller firms we reached were not known to experts in the development agencies, and in fact the possibility of finding a "digital" network was denied by some, so a survey method could not have uncovered them.

[6] Thanks are due to Dimitrios Christopoulos for insightful discussions on this issue.

In a recent paper (Heath et al. 2009) discuss some of these issues and argue for a more "qualitative" approach to SNA. They observe that "quantitative" SNA - whether it constructs networks through a realist or nominalist method - is in fact subject to the same problems, because networks are actually "permeable, partial and dynamic" in nature, although such studies "proceed on the basis that – for purposes of analysis, if not conceptually – a firm boundary can be drawn around the network to be studied" (Heath et al. 2009, p.657). By contrast, they claim, a "qualitative" approach explicitly (and unavoidably) includes "the processes of inclusion and exclusion which occur through the filtering and selection mechanisms deployed by network members", (p658) so contributing to understanding of the operation of social networks and to methodological development in SNA. Moreover, in their view, "the dynamic and shifting nature of social networks" is "as much a substantive issue as it is a methodological one." (Heath et al. 2009, p.658).

To summarise again, our sampling design inter-relates with the other phases. For example:

- purposive sampling is consistent with the post-positivist paradigm and qualitative inquiry
- selection of seeds for Expanding Selection was guided by theory and our conceptual framework
- research in a "natural setting" influenced our style of analysis and comparative measurement toward narrative accounts (rather than, for example, statistical or econometric analysis)
- the "natural setting" also required us to address issues of confidentiality, consent and ethics during Data Collection and Analysis
- we used the partially-constructed networks that resulted from earlier "waves" in Expanding Selection to assist us in recruiting subjects (i.e. we asked for referrals)

Data Collection

From the Mixed Methods perspective our approach to data-collection is "concurrent" and "nested" (Creswell et al. 2003; Creswell & Plano Clark 2007). We collected data at multiple levels of analysis at the one time. Specifically, we collected quantitative data on actor-attributes, (quantitative) relational data on network linkages, and qualitative data on the actor's normative and cognitive perspectives in a single interview using an integrated research instrument.

We followed Johnson & Turner's approach for what they call "inter-method mixing" (Johnson and Turner 2002) using an Interview Guide combined with a "Quantitative Interview". We used the Quantitative Interview primarily to gather attribute and relational information for SNA. We followed that with a traditional semi-structured interview in which we collected (network-oriented) qualitative data. We note that while the Quantitative Interview may "bias" the subsequent qualitative interview, any such bias is likely to be in ways that focus respondents' interpretations towards a "network" view, which is what we desire in relation to our research questions.

This approach has a number of advantages: it is more efficient in time and travel; it allows for the use of face-to-face interviews, important in developing the trust required for reliable relational and qualitative data collection about topics that may be sensitive or confidential to the business [(Marsden 1990, p.441; Illenberger et al. 2010, p.4)]; and valuable information has often emerged along "overlaps" in the various parts of the interview process. We also note that we sought interviews with the owners or founders of these small or medium-sized businesses so as to minimize problems of "specialization within organizations" (Marsden 1990, p.443) and to maximize the accuracy of responses about inter-organizational ties.

Expanding Selection uses a "name-generator" rather than a complete "roster" of pre-determined network members. Our questions used the phrase *"Please list your top suppliers (customers, allies etc.) …"*. This was chosen deliberately to be idiomatic and so to encourage the respondent to think in terms of alter's subjective importance to him. So "top" to some might mean current monetary value, for others historic or cumulative monetary value, and for others strategic or projected importance. In that relations and network structure guide the actor's business strategy, this subjective measurement of the relational context is a consistent one.

The respondent was free to list as many relations as they wished (Holland & Leinhardt 1973). Name interpreters recorded some additional attributes of the relation itself:

i. the geographic location of the alter;
ii. how the relation was initially established;
iii. the primary means of communication with the alter (or gaining knowledge about, in the case of a competitor).

Qualitative data were gathered using a conventional semi-structured interview, with themes organised around the role of the various forms of proximity in building business relations, and indicators of knowledge inputs and processes of learning and innovation. There are two points however that are more specific to our study:

1. The research design is organised around "network relations" and many of the themes we are interested in, even in the qualitative strand, are network-centric. Thus, for example, we are not interested in the reasons why a respondent was motivated to be an "entrepreneur", but we are interested in why she took actions to "position" her business "better", to make a wider circle of connection, or to seek new sources of knowledge from outside the region.

2. We are interested in "normative" aspects of a respondent's actions, as alluded to in the example above. In particular we are interested in information that relates to the establishment and the evolution of the network, and to the ways in which respondents "experience" and seek actively to reconfigure their network (or networks).

Once more, summarising relationships between this and other phases of the design, we note that:

- concurrent data collection meant that as inputs to Analysis we had three "streams" of data: attributes, relations, and qualitative accounts. We will describe in the next section how these were recorded and processed
- name generators resulted in a multiplex, directed network
- name interpreters gave rise variously to attributes of actors and of relations
- qualitative data was linked to individual actors – thus to "cases" (in NVivo) and to nodes (in SNA)

Analysis & Interpretation

In conclusion, we describe a little of how our two strands of inquiry were integrated and interpreted. More details are provided in other publications (Sloane & O'Reilly 2010, Sloane & O'Reilly forthcoming, Sloane & O'Reilly submitted, Sloane & O'Reilly 2011). Earlier choices about sampling and data-collection had a bearing here again, for example leading us away from hypothesis testing or correlation of attribute and relational data, but instead toward perspectives on validity that are more typical of qualitative studies.

Data Collection resulted in three 'streams" of data, as mentioned above. The first, attribute data, was stored in Excel, from where it was imported into UciNet (Borgatti et al. 2002) as attribute matrices or VNA files, and into NVivo (QSR International Pty Ltd. 2008) as a casebook. Relational data was stored as DL files and analysed with UciNet[7], generating network visualizations (EMF and JPG files) and data tables. Qualitative data was stored as audio (MP3) files; these were imported into NVivo, qualitatively coded and excerpts transcribed.

We created four subsets of qualitative (thematic) codes: one derived from theory and the themes in the interview guide; another derived from the deductive "hypotheses"; a third from SNA concepts – centrality, bridging, sub-groupings, triadic structure etc.; and fourth, a set of "in-vivo" codes that arose inductively from the data. We used SNA to guide qualitative inquiry – which could be seen as a "qualitising" of the SNA visualisations (Teddlie & Tashakkori 2009b, p.256). Working in the other direction, we used qualitative data and results to interpret actors' positions and sub-structural features of networks identified through SNA, which is the more "traditional" process in SNA (Edwards 2010).

Turning in conclusion to interpretation and to questions of generalizability and external validity, we note that a fundamental claim in our research is that a "network" encompasses

[7] For some algorithms we used Pajek, e.g. p-clique (NEGOPY) and Triad Census.

significant aspects of the social processes and structure of an "enclosing" social system. Laumann at al note that this is not a necessary condition for the use of SNA:

> "there is no sense in which social networks must 'naturally' correspond to social systems" (Laumann et al. 1983, p.78).

In other words, we could study a network as an entity in itself, and not make any claim that it represents aspects of a wider social system[8]. We do however wish to make such a claim – that we can gain insight into the functioning of a rural economy by analysing networks "contained" within that economy and interpreting the results. Laumann et al. found such claims to be widely accepted and "plausible":

> "Given a suitable definition of [the social system i.e. the basis of mutual orientation of its members] the network boundaries for actors, relations, activities and events may be specified such that they can be plausibly equated to those of the social system under study." (Laumann et al. 1983, p.78).

Brian Uzzi also, in his well-known study of the "Garment District" in New York City ((B. D. Uzzi 1993; B. Uzzi 1996), used the term "plausible", and stated that his goal was not to establish a "positivist proof" of his theoretical framework but rather to "demonstrate its plausibility and how it helps us to understand the effect of social structure on economic life" ((B. Uzzi 1996, p.675).

In the same period Richard Rothenberg wrote:

> "In [SNA], estimation about some larger population (to which this smaller population is related) and generalizability to other populations cannot be based on sampling theory" (Rothenberg 1995, p.108)

Rather, he advocated the use of "ethnographic observation" (of both larger and sample population, to be precise) and cross-comparison of information from such observation with the results of SNA. Using today's terminology, we may thus claim him as an advocate of Mixed Methods.

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[8] A recent article claims that this distinction characterizes a key difference between work on networks in social science and work in physics and mathematics (Borgatti et al. 2009, p.895).

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