

Presenting Ethnography in the Requirements Process

John Hughes, Jon O'Brien, Tom Rodden, Mark Rouncefield, Ian Sommerville
Departments of Computing and Sociology
Lancaster University
Lancaster LA1 4YR

Email: {soa010,soajeo,soa031}@cent1.lancs.ac.uk; {tom,is}@comp.lancs.ac.uk

Abstract

In this paper we argue that the industrial development of interactive systems has to recognise the social dimension of work if these systems are to fully meet the real needs of their users. Under current approaches this depends on whether an individual requirements engineer implicitly applies a user-centred approach, recognises the importance of cooperation and is sufficiently sympathetic and intuitive to understand the work and reflect this in the system requirements. We wish to move beyond this by allowing for the provision of a more systematic incorporation of the social dimensions of work. To this end we focus on developing a novel approach to the presentation of ethnographic material. Our approach is based on the use of number of viewpoints and is embodied within a general hypertext tool.

1. Introduction

Over the last few years, ethnography has been proposed as a new approach to 'requirements elicitation' in systems development. The turn to ethnography is a response to the need for an adequate understanding of the nature of work to underpin large scale interactive system development. In the context of system design, ethnographic studies have included photocopier use[1], office work[2], air traffic control[3], police work[4] and underground control rooms[5]. However, although holding much promise, ethnography is still an untried method in system design. It has been, and still is, strong on its critique of other methods, such as Task Analysis[6], but it has yet to prove itself within the wider community of software engineering, particularly to those working in commercial and industrial contexts.

In this paper we present an outline of our own experience of using the method and suggest some roles which ethnography can play as a contributor to the requirements process. Though we are strong supporters of the method we do not regard it as a panacea for the complex and 'wicked' problems of requirements engineering and systems development. In fact, if ethnography is to take a place in systems engineering, then it is important to assess its utility within the requirements process. Our starting point is an examination of the arguments that have motivated the introduction of methods such as ethnography into systems design. In previous papers[7] we have highlighted two

principle factors which impede the widespread acceptance of ethnography as a means of developing requirements.

- The pressures of time and the duration of ethnographic studies.
- The difficulties of communication the emerging results of the ethnographic study.

In this paper, we seek to show how we have responded to these demands both in terms of our use of ethnography and how we communicate the contents of the associated ethnographic record to developers. In particular, we wish to focus on the way in which we have chosen to present the results of ethnographic studies to inform the development of more abstract models of work in the requirements process.

2. The case for ethnography

The increased prominence of interactive systems has seen a movement of computer systems out into the world of work and organisation[8]. Developers of these systems have turned to ethnography to complement existing human centred methods of systems development. The incorporation in system design of a social perspective and the prominence of ethnography emerges from a growing plausibility of the diagnosis that many system problems emerge because their design pays insufficient attention to the social context of work. This failure is often attributed to the inadequacy of existing methods of requirements elicitation and work analysis[9]. Critics stress that methods owe far too much to the needs of engineering with the result that crucial aspects of the 'real world' are never properly treated. It is in this respect that 'analytic approaches' which 'decompose' work into activities and tasks or which focuses on the flow of data within a domain, are found wanting[1,9]. The result is that essential aspects of the socially organised character of the domain concerned are obscured or, worse, misrepresented.

It is also increasingly accepted within the software engineering community that understanding the 'social' real world is an important factor in software design and development[10]. A growing expectation is that requirements elicitation should be informed by an analysis of the 'real world' circumstances of work and its organisation[11]. As a result, it is no surprise that ethnography emerges as a candidate method for understanding the human nature of requirements.

The principle virtue of ethnography is its ability to make visible the 'real world' aspects of a social setting. It seeks to present a portrait of life as seen and understood by those who live and work within the domain concerned. The intention of ethnography is to see activities as social actions embedded within a socially organised domain and accomplished in and through the day-to-day activities of participants. It is this ability of ethnography to describe a social setting as it is perceived by those involved in that setting (the archetypal users) that underpins its appeal to developers. In particular it offers the opportunity to reveal the 'needs' or practices 'users' may not be aware of (as part of the 'taken for granted' aspect of work) or are unable or unlikely to articulate (because of power relationships in organisations). As part of this initial process ethnography is valuable in the identification of the exceptions, contradictions and contingent practices in the flow of work. However, ethnography is not without its problems and the effective application of ethnography in the requirements engineering process needs a number of problems to be addressed. Of particular importance are the issues surrounding time and communication. Viewed from a computing perspective, ethnography is a 'prolonged activity' and in the context of social research can last a number of years. Addressing the pressure of time is not a simple matter of needing to 'speed up' ethnography and get it done more quickly. The use of ethnography in requirements elicitation is not simply a question of finding the 'right method' and 'getting it done'. Of equal importance is 'getting it understood' and communicating ethnographic findings to designers. The outputs of ethnographic analyses are typically discursive and lengthy reports, which appear to have little in common with the description techniques that are standard in systems engineering.

As for any other method, with ethnography there is a strong sense of 'diminishing returns' on the investment in time and effort in the fieldwork phase. There seems to be a point in time - and it often comes quite early on - when no new insights or information are being uncovered. To address this effect we adopted a 'quick and dirty' approach where fieldworkers undertook short focused studies to quickly gain a general picture of the setting. The phrase 'quick and dirty' does not refer simply to a short period of fieldwork but signals its duration relative to the size of the task. The use of ethnographic study in this manner not only seeks relevant information as quickly as possible but accepts at the outset the impossibility of gathering a complete and detailed understanding of the setting at hand. Rather the focus is on informing strategic decision making to select those portions of the work setting of particular importance in informing design.

This 'quick and dirty' approach is capable of providing much valuable knowledge of the social organisation of work of a large scale work setting in a relatively short space of time. Indeed, it can be argued that the 'pay off' of the 'quick and dirty' ethnography is greater in that a great deal is learned from a relatively short time expended on fieldwork. What the 'quick and dirty' fieldwork provides is

the important broad understanding that is capable of sensitising developers to issues which have a bearing on the acceptability and usability of an envisaged system rather than on the specifics of development.

Few of these issues surrounding the exploitation of ethnography are easily resolved. However, it is important not to be too ambitious for any method, least of all in software engineering where new methods follow one another with monotonous regularity. Design is a 'satisficing' activity, often dealing with 'wicked' problems[12] and a matter of doing the best one can with the resources available. Nevertheless, if it is accepted that designers should be informed about the social character of work, and that ethnography is an important means of gaining such knowledge, then serious attention needs to be given to the ways in which the results of ethnographic studies can be presented to developers within the requirements process.

We have adopted two distinct responses to the demands of incorporating ethnography in the requirements process. Firstly, we have adopted a *process response* by developing alternative 'quick and dirty' approaches to incorporating ethnography in the requirements process (see in particular[13]). This strategy seeks to respond to the demands of time central to industrial development. Secondly, we have developed a *communication response* by developing a systematic approach to the presentation of ethnographic information. This allows the results produced by a study of a work setting to be more widely communicated across a large development team. In this paper we wish to focus on communication and the presentation of ethnographic information across a development team.

3. Presenting ethnographic information

Our experiences in using ethnography in the requirements process suggest that appropriate models can be developed to exploit ethnography[13]. However, these studies also revealed a more acute problem; the need to communicate the results of the studies to designers in a form which they could understand and use. The development of techniques for presenting ethnographic information to designers is a key prerequisite for involving ethnography in requirements process. The 'debriefings' that form a central part of ethnographic study should not be conceived of as the forum for unproblematic or mechanistic *delivery* of requirements from fieldworker to system designer. Rather, the cross disciplinary nature of these meetings needs to be borne in mind, with all the implications this entails for the effective communication and discussion of fieldwork findings. This is a crucial consideration, since it is in these discussions that ethnography's contribution to the requirements process is constituted: getting the ethnography 'done' includes 'getting it understood'. Our response to the challenge of effective communication has been to focus on a more

systematic means of structuring the results of ethnographic studies. This systematic approach has two key elements:-

- A means of organising data within the ethnographic record produced by the fieldworker.
- Tool support to allow the structured ethnographic record to be presented to engineers to support the development of requirements.

The development of this approach has built upon an existing design rationale tool that supports the rapid construction of the directed graphs widely used in structured methods. We have complemented the use of this tool with an exploitation of viewpoints as a means of structuring the ethnographic material to promote the construction of abstract models of work as part of the requirements process.

3.1 Viewpoints onto ethnographic data

Some more recent methods of requirements engineering have adopted the notion of viewpoints[14] where it is explicitly recognised that requirements for a system derive from different sources who may have quite different perceptions of the system. These 'viewpoint-based' approaches are principally concerned with looking at viewpoints in isolation rather than as cooperating entities. They are concerned with reconciling conflicting needs (which is a key problem in requirements engineering) rather than identifying viewpoint interactions and links. Proponents of these methods recognise the importance of cooperation[15] and these viewpoint-oriented approaches may include explicit cooperation specifications in the future. However, viewpoint based approaches are focused on a recording of the detailed relationships between the computer system and users rather than a more general examination of the nature of systems within a context of work.

We wish to exploit the notion of viewpoints as a means of presenting the emerging results of ethnographic studies. That is, rather than use the notion of viewpoints as an approach to requirements discovery we wish only to deploy the viewpoints idea more as a structuring mechanism on the corpus of ethnographic information within the ethnographic record. The adoption of a technique based on viewpoints allows us to present information in a form that makes explicit the different but complementary interests involved in the design process, particularly the interests of providing an adequate characterisation of the sociality of the setting and those of engineering.

The presentation of different viewpoints also allows alternative views and perspectives to be set alongside each other as a resource for designers and requirements engineers in formulating the abstract models essential to the requirements definition process. In summary, a number of particular reasons motivate our choice of viewpoints as a means of involving ethnography in the development of requirements for interactive systems.

- They highlight the multiple orientations people may have to a supporting system, not all of which are conflicting.
- They are naturally sympathetic to the heterogeneity evident within the development of requirements
- They provide a means of setting the multiplicity of user needs along side each other to inform the construction of requirements.
- They are becoming widely accepted in the development community and dissemination of ethnographic information in a development context will be enhanced.

The last of these points is central to the need to support multi-disciplinary working when formulating requirements from a human centred focus. The problems of differing vocabulary, disciplinary traditions and approach are significant when we consider the incorporation of any human centred method into the engineering tradition of systems development[16]. By adopting a common vocabulary that is understood within the target domain of requirements engineering we seek to minimise these problems.

It is unlikely given the nature and scale of the development process within real organisations that requirements approaches are likely to move significantly from the existing representation techniques, particularly given that they represent a significant investment of resources. We are not proposing an approach that requires existing methods and tools to be abandoned or modified. Rather, we are augmenting the initial phases of the requirements engineering process so that the structured models developed using existing methods take account of social factors and have associated supporting rationale as discovered through the ethnographic study.

4. Presentation viewpoints

It is important at the initial stage of the requirements process that adopted techniques are not too restrictive in approach but instead promote flexibility of interpretation. We focus on the use of viewpoints as a simple means of classifying particularly pertinent aspects of the study rather than as a means of analysis and requirements specification. While we would argue that 'viewpoints' do not emerge automatically nor allow requirements to be straightforwardly 'delivered'; the analytic purchase of ethnographic techniques is such as to facilitate the process of viewpoint identification. One consequence of this methodological decision is that we see viewpoints as dynamic and emerging and offer them to analysts as a mechanism for supporting specification judgements. The viewpoint identification process is one that emerges from the ethnographic data, rather than from the application of an a priori set of analytic categories. In this model the process of collaboration between ethnographers and system designers is integral to the identification of viewpoints in the fieldwork data and an assessment of the relevance and appropriateness of those viewpoints to instantiation in the

system design. It is precisely this collaboration that the developed tool is designed to support.

Currently, ethnographic records are closely associated with the fieldworker undertaking the study of work. There are strong practical considerations for ensuring that this remains the case. Fieldworkers construct the ethnographic record essentially as an 'aide-memoir' to allow them to later recall features of the work. The record is a heterogeneous collection of information involving a wide range of media. It includes examples of existing paper information, audio and video records, and sketches and notes made by the observer. The collecting of this information is essentially a personal endeavour that often only makes sense to the observer. In addition, the ethnographic record acts as a gateway between the domain of study and development. Altering the relationship between the fieldworker and the ethnographic record in any substantial manner has significant methodological implications for the ethnographic study. Consequently, we have chosen to focus on the provision of facilities that allow a fieldworker to deliver information from a study to developers involved in the construction of a requirements specification. These facilities are not intended to replace the diverse collection of materials that currently constitute the ethnographic record rather they offer an additional means of recording and representing the information. In other words, this is not offered as an analytical tool to use in the field by an ethnographer but is instead to present fieldwork materials to developers once gathered and written up.

In structuring the fieldwork materials we have specified a small set of viewpoints, each of which represents a particular focus on the social organisation of work activities within the domain. The viewpoint categories have been chosen in order to bring out key aspects of the sociality of work in a way which enables the development of abstract models based on the fieldwork materials. These viewpoints are intended to highlight the setting of the work, the social context of the work and the practical organisation of the work taking place.

4.1 The setting of work (*The ecology of work*)

The first of our viewpoints focuses on the development of a representation of the setting of work and how users work within a flexible working division of labour. Work is a particular and practical everyday experience which does not take place in abstract isolation removed from the contingencies of the real world. Rather these contingencies directly impact on work and impose particular structures within the work taking place. One way of reflecting the practical everyday nature of the work is for accounts of the fieldwork to focus on its setting. This is often reported in terms of the physical layout of the location in which work is taking place. This viewpoint seeks to represent the spatial distribution of the workplace in terms of its participants, the work they do and the local resources that they use. The purpose of this is to provide a sense of 'where the work takes place' and the socially constructed

affordances that this offers as an arena of various kinds of interactions that take place. In this respect, it is a view upon the workaday character of the world within its setting.

4.2 Social and organisational perspectives on work (*Views of work*)

This viewpoint highlights the loosely structured and practical focus of ethnographic studies of work. Ethnographic studies typically do not begin using a highly structured set of theoretical categories. Rather, their emphasis is on providing materials on the 'real world, real time', nature of work which can be used for sociological analysis. These materials furnish portraits of the practical nature of work, often presented as illustrative vignettes within a larger report. The analysis typically tries to bring out the day-to-day experience of the work from the point of view of various actors within the setting. Each of these actors have informal, incomplete and often inconsistent models of the work taking place each of which provides significant insight in the development of abstract models in the requirements process.

This viewpoint aims to collate summaries of this body of observational information in such a manner that they are accessible by developers as a resource for requirements specification. Given the relatively discursive presentation of this material as well as its focus on the subtle, often 'invisible' or tacit, features of workaday activities, this viewpoint is really a collection of potential viewpoints from which such materials can be examined, depending upon the interests of the designers. Observers and developers are free to add additional perspectives relevant to the study as a means presenting this information. For example, it may be presented from the point of view of a particular actor within the work setting, a sequence of tasks, a collaborative endeavour, the policy of the organisation, and so on.

4.3 Work flow (*The flow of work*)

This final viewpoint is again probably best seen as a collection of potential viewpoints, and focuses more directly on sequences of work activities, information flows, and so on. In this respect it emphasises and exhibits the division of labour within the work along with its various interdependencies; interdependencies which are not always formally specified. The kind of fieldwork materials germane to this viewpoint include 'tracking work' through its sequences and transformations, such as a particular piece of software through error testing, the flight of particular aircraft through UK airspace, invoice processing, and so on. Once again, such materials will consist of reports of activities, the relationships among parties to the work, how the interdependencies are achieved as 'real world, real time' phenomena, the contingencies that can arise, how they are dealt with, and so on. This material is normally textual though use is often made of simple diagramming techniques.

Using a series of initial experiments as a basis[7] we have augmented a tool aimed at supporting design rationale to act as means of presenting ethnographic information. The tool allows the rapid construction and amendment of design information formulated as directed arcs. Given the prominence of this form of representation as a means of structuring requirements we have chosen to add facilities that allow the representation of viewpoints to this tool. It has been developed using a rapid prototyping approach based on the observation of its use in a series of early stage design and requirements specification sessions[17]. During all of the initial prototyping sessions the system was used as a structuring tool by more than one user. Similarly, a significant proportion of the presentation of the ethnographic information was developed jointly by the observer and the requirements engineer.

5. Presenting the ethnographic record

In this section we present some of our initial experiences of using our viewpoints to structure the presentation of information. The focus for our study was a technology centre within a large multi-national company that manufactures cables. Until recently, the company's policy was to locate technical expertise in particular centres which would provide consultancy on specific problems and technical issues as they arose in various manufacturing sites as well as undertaking product related research and development. The company is currently actively seeking to provide more direct access to this expertise using electronic communication facilities. A central part of this initiative has been the migration of information from existing paper based technical reports to an electronic representation. This involved the development of an electronic data system into which existing reports were scanned. The company had invested in electronic storage facilities and scanning software to undertake initial prototyping trials.

Our particular site of study was a technology centre in the North West of England. It comprises three organisational elements: the office, the laboratories, and the Pilot Plant. The centre serves various manufacturing businesses that are part of one of the divisions of the multinational company, and is one of three such centres all established in the mid-1980s. Links with the various businesses are through a combination of regular formal meetings, informal personal contacts and 'firefighting' problems as they arise.

The office is a large open plan on the first floor of the technical centre building. The Pilot Plant is a large factory building adjacent to the office and labs which contains a variety of testing and production line equipment. It is occasionally used for the post-development production of highly specialised products. The nature of the work of the technology centre requires a sophisticated technical infrastructure including not only the equipment concerned with research and development but also workstations for each of the technical staff.

5.1 The Presentation of Information

Given the nature of their role in the larger organisation as a service provider the technology centre places considerable emphasis on the importance of quality control and has invested significant resources in gaining accreditation for its work processes from a range of professional bodies including ISO-9000 certification. This feature of the technology centre is often crucial in securing contracts for the manufacturing division and the organisation wishes to preserve it.

One result of the focus on the work process is that a number of representations and flowcharts currently exist as part of the work of the technology centre. These representations provide a useful starting point for structuring the results of our study given their general acceptance across the organisation. The screen shot in figure 1 shows the representation of the development and accreditation of a technical report and the archiving of technical reports within the centre. These representations are based on documents used across the organisation which were transposed into our system. One way of considering our task was the development of more detailed models of work to support the construction of requirements based on these initial process outlines.

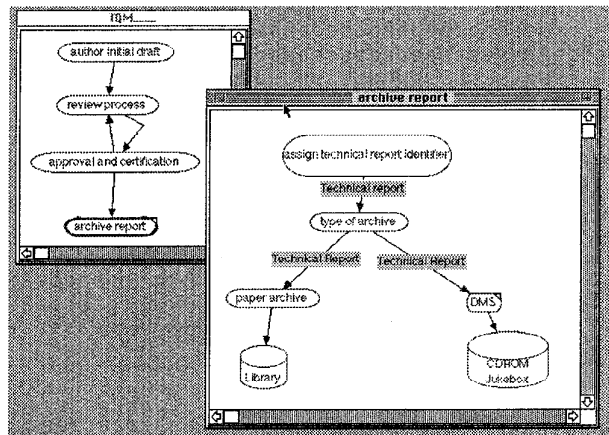


Figure 1 : The technical report process.

Our particular focus in reporting the results of the study is on the document management centre. This is the point in the process where documents are converted to an electronic form and stored in a CD-ROM jukebox for later recall. This part of the process was unspecified and our work required us to develop an abstract representation of the work involved. This provided a natural focus for this part of the study and allowed us to exploit the simple viewpoint structuring facility shown in figure 2. This feature of the tool allows users to collect together the information associated with three viewpoints outlined in the previous section and the abstract representation of the process resulting from an examination of this part of the process. In this case we see that we have recorded a selection of

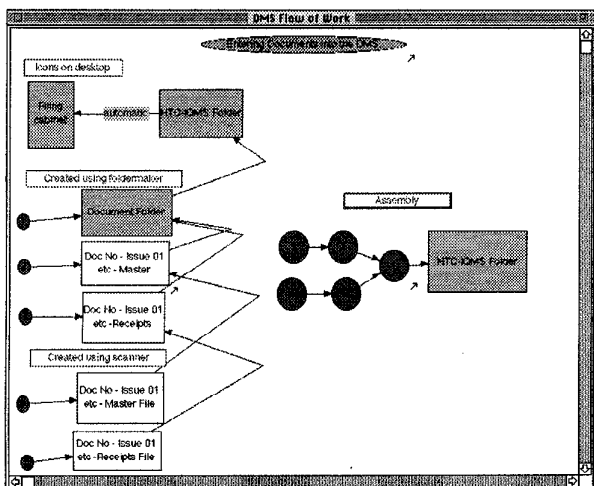


Figure 5 : The flow of work viewpoint for the DMS.

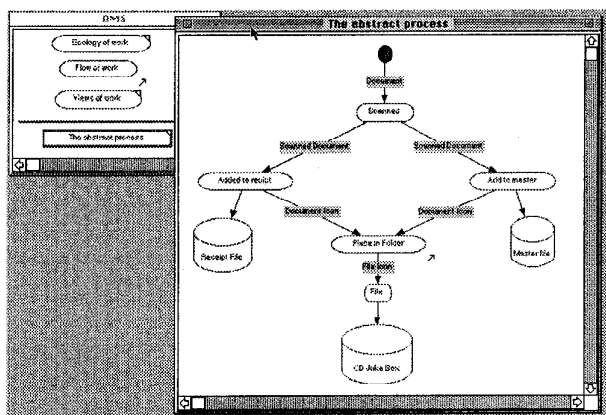


Figure 6 : The abstract representation of work

6. Lessons learned and future work

Our experiences of using ethnographic studies within the requirements engineering process have involved us amending the nature of the ethnographic studies undertaken and developing an alternative way of incorporating their results into the process. This approach has been complemented by the development of techniques to structure and make more accessible the ethnographic record central to studies of this form.

Early experiences of ethnography stressed its use to inform the development of requirements for new systems at the outset of the requirements process. These experiences also highlighted the problematic nature of the extensive duration of studies. Our more recent experiences suggest that within the development process ethnographic studies have a diminishing return in the formation of requirements. Consequently, we have exploited short focused

ethnographies that allow us to selectively target studies to meet the needs of the requirement process[13]. In addition to the initial formation of requirements we have used these focused ethnographic studies to assess existing requirements specifications.

We have found the unstructured nature of the ethnographic record to be particularly problematic. The traditional role of the private set of fieldworker's notes makes information from an ethnographic study difficult to access. We have tackled this by developing more structured techniques for presenting ethnographic information to developers. This allows traditional models of work (such as that shown in figure 6) to draw upon a larger corpus of informal material extracted from an ethnographic study. This informal material would not normally be recorded or remembered in traditional approaches to developing these models.

Our structuring approach exploits the notion of viewpoints to highlight and record the diversity of perspectives evident in the social world. Suggesting an initial set of viewpoints also allows us to move toward a more systematic approach to ethnographic studies in the development process. Our investigation into the utility of viewpoints for presenting ethnographic information exploits a hypertext based tool for recording the information. The use of a tool enables the construction and sharing of the rationale supporting the development of abstract models. In our case this rationale is expressed as a collection of observational material linked to an abstract model using the cross referencing facilities provided by the tool.

Our experiences to date suggest three main themes of research for the successful incorporation of ethnography into the requirements engineering process.

- An examination of the different ways in which studies of work can be involved in the requirements process.
- The development of tools and appropriate and consistent semantics which support the recording and presentation of informal information.
- The use of more structured approaches to ethnographic studies that are intended to support the development of requirements.

The use of our viewpoints provides us with the communication between observer and developer needed for an investigation of different models for using ethnography in requirements engineering. In addition, we feel that meeting the demands of a defined set of viewpoints provides a way of developing a more structured approach to ethnographic studies in the context of requirements engineering. Our intent is to exploit the construction and use of support tools as a means of developing these research themes.

7. Summary

Ethnographic study has a long tradition as a means of understanding the everyday aspects of work settings. In this paper we have focused on the use of viewpoint techniques as a means of structuring the presentation of the results of ethnographic study to enable the construction of more abstract representations of work. Our presentation techniques rely on the use of three viewpoints; the work setting, the flow of work and the organisational and social perspectives on work evident in the study. Each of these stresses a different aspect of the study important in understanding the nature of the work taking place. They also suggest a set of potential foci for ethnographic studies being undertaken with a view to informing systems development. The different viewpoints have been incorporated into a rationale tool that we have used to construct a set of abstract models of work capable of being used in the specification of requirements. It is important to stress that the different viewpoints are seen as complementary to each other by representing the materials in a form which is more attuned to the various tasks in the design process, especially in the formulation of requirements. We are currently applying the three viewpoints outlined in this paper as a means of structuring the presentation of a number of additional studies. These include the study of a national bank, a building society and a software development team. We hope to be able to develop a set of general experiences that can inform the development of an ethnographic approach to requirements development.

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