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2008

# Assimilation of enterprise resource planning (ERP): a multilevel model

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## Publication Details

Shen, K. & Khalifa, M. 2008, 'Assimilation of enterprise resource planning (ERP): a multilevel model', Pre-ICIS Workshop on Enterprise Systems Research in MIS,

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# ASSIMILATION OF ENTERPRISE RESOURCE PLANNING (ERP): A MULTILEVEL MODEL

**Complete Research: 4047 words**

**Mini-Track: ES Organizational Issues**

Abstract (198 words)

*ERP assimilation involves both strategic levels and individual level. Focusing on either micro or a macro stance yields an incomplete understanding of behaviour occurring at either level. The main objective of this research is to bridge across different levels of analysis in understanding ERP assimilation. First built upon the existing experiences with ERP software application and prior research, we conceptualize ERP assimilation to be multilevel, including three dimensions of ERP assimilation across different organizational levels, i.e., strategic level, activity level, and individual level. Drawing upon Institutional theory and empowerment theories, we integrate macro and micro approaches to develop a multilevel model explaining ERP assimilation. Top management championship and empowerment climate are proposed to be factors influencing ERP assimilation in corporate strategies and value-chain activities; while psychosocial empowerment is the main driving force for individual ERP assimilation and satisfaction with ERP. Empowerment climate serves as the mechanism translating the influence from organizational level to individual level and its effect on ERP assimilation at the individual level is mediated through psychological empowerment. Furthermore, empowerment climate is also argued to dampen the direct effect of top management championship on ERP assimilation in value-chain activities. The theoretical and practical implications are discussed.*

*Keywords: ERP Assimilation; Multilevel Model; Top Management; Empowerment Climate; Psychological Empowerment; Institutional Theory*

# 1 INTRODUCTION

ERP, according to Swanson (1994), is a kind of Type III innovations that have strategic relevance for firms as its integration into the core business processes or strategies could directly impact financial performance. What differentiates ERP from a collection of functionally specific specialized applications is the value of enterprise-wide software integration within and beyond a firm's boundary, which allows a greater degree of process automation of routine tasks as well as more comprehensive data analysis and reporting capabilities to improve discretionary management decisions (Hitt et al. 2002). The anticipated benefits have driven substantial investment in ERP around the world. However, an enduring pain of most companies adopting ERP is to realize its full benefits after successful installation of ERP software.

ERP assimilation has been defined as the extent to which the use of the technology diffuses across the organizational projects or work processes and becomes routinized in the activities of those projects and processes (Fichman and Kemerer 1997; Purvis et al. 2001). Some literature also uses deployment or extent of adoption as alternative terms for ERP assimilation. Different from ERP implementation or adoption which, from project management point of view, only measures the installation of ERP within organizations, ERP assimilation goes beyond to involve actual usage of ERP and integration with organization activities and individual tasks. Some literature also uses deployment or extent of adoption (Hitt et al. 2002) as alternative terms for ERP assimilation. Much evidence has demonstrated that without intensive usage and routinization, organizations may not be able to reap the claimed benefits of ERP but result in financial loss. In addition, prior research also reported a consistent and strong positive correlation between assimilation or actual usage and return of investment (ROI), indicating that assimilation should be considered as an integral part of ERP project evaluation and as a more suitable indicator for ERP success. However our understanding of ERP assimilation remains at the early stage (Liang et al. 2007).

One reason contributing to such incomplete understanding of ERP assimilation is the lack of multilevel studies. Most IS research investigates ERP assimilation by conceptualizing and examining at single levels of analysis (e.g., individual, organization, institutional). Researchers, adopting a macro stance, have proved a positive linkage between metastructuring activities, e.g., top management support, strategic rationale and coordination, and Web assimilation (Chatterjee et al. 2002). However, we still do not fully appreciate how such metastructuring activities are unfolded and implemented within organization and influenced and informed by individual activities. On the other hand, research adopting a micro lens focuses on individual ERP usage behaviour. Such studies usually explain ERP assimilation by using the similar theories explaining adoption behaviour, neglecting the distinctions of ERP assimilation as post-adoption behaviour (Jasperson et al. 2005). Furthermore, such studies oversimplify or ignore the broad organizational and social context for such post-adoption behaviours (Jasperson et al. 2005). Although research conducted at the different single levels enriches our understanding, it also implies the necessity for using multilevel lenses to reveal the complexity in phenomena. Particularly, ERP assimilation involves both strategic levels and individual level. Focusing on either micro or a macro stance yields an incomplete understanding of behaviour occurring at either level.

Thus, the main objective of this research is to bridge across different levels of analysis in understanding ERP assimilation. First built upon the existing experiences with ERP software application and prior research, we conceptualize ERP assimilation to be multilevel, including three dimensions of ERP assimilation across different organizational levels, i.e., strategic level, activity level, and individual level. Strategic assimilation means the extent of use ERP to enable and shape companies' strategies (Armstrong and Sambamurthy 1999; Chatterjee et al. 2002). Activity assimilation refers to the extent of use of ERP to support and enable value chain activities (Armstrong and Sambamurthy 1999). Individual assimilation refers to the extent of use of ERP to support and enable tasks performed by individuals. Drawing upon

Institutional theory and empowerment theories, we integrate macro and micro approaches to develop a multilevel model explaining ERP assimilation. Specifically, top management championship and empowerment climate are proposed to be factors influencing ERP assimilation in corporate strategies and value-chain activities; while psychosocial empowerment is the main driving force for individual ERP assimilation and satisfaction with ERP. Empowerment climate serves as the mechanism translating the influence from organizational level to individual level and its effect on ERP assimilation at the individual level is mediated through psychological empowerment. Furthermore, empowerment climate is also argued to dampen the direct effect of top management championship on ERP assimilation in value-chain activities. This research represents the first attempt to develop a multilevel model explaining ERP assimilation, identifying the mechanism accounting for the interplay between organizational level and individual level in ERP assimilation and the interaction among metastructuring actions.

This paper will be organized as follow. We first review the prior studies and discuss the need for a multilevel approach. Next we develop a multilevel model explaining the factors at individual and organizational levels driving ERP assimilation and justify the propositions. This is followed by a discussion of the theoretical and empirical implications. Finally we conclude the paper with a discussion of future research directions.

## **2 LITERATURE REVIEW**

Compared to large volume of research on IT adoption or ERP adoption, ERP assimilation has received less attention (Liang et al. 2007). Different from ERP adoption which means the development of the “first” successful system using a new information processing technology, assimilation is concerned with a transfer of this success to other relevant applications, i.e., the spread of the innovation through the target social system, which is also referred to as diffusion (Roger 1995). Depending on the unit of analysis, i.e., whether the research focuses

on the individual as the entity for ERP assimilation or the organization as the innovation system, different theories have been used to explain ERP assimilation.

Consider organizations as the innovation system, several studies (Chatterjee et al. 2002; Liang et al. 2007) conceptualize ERP assimilation at the organizational level and define assimilation as the extent to which the use of technology diffuses across the organizational projects or work processes and becomes routinized in the activities of those projects and processes (Purvis et al. 2001). In this regard, institutional theory (Scott 1995) has been applied as one prevailing perspective to explain ERP assimilation (Chatterjee et al. 2002; Purvis et al. 2001). According to this theory, individual behaviours within organizations are significantly influenced by the prevailing organizational norms, values, culture, and history. Different institutional structures such as organizational routines, rules, regulations, and procedures are a microcosm of the institutional norms, values, and history and serve as powerful templates of action in guiding individual behaviour. Three ways in which the institutional structures influence individual behaviour are:

- Structures of signification, whereby the prevailing institutional structures yield meaning and understanding.
- Structures of legitimation, whereby the prevailing institutional structures validate specific behaviours as being appropriate in the organization and consistent with the goals and values of the organization. This serves as a normative template for individual behaviour.
- Structures of domination, whereby the institutional structures regulate individual actions and behaviours.

Orlikowski et al. (1995) further suggested two sets of actions characterizing the dynamics of technological use in organizations: individual structuring actions and metastructuring actions. But most prior research following institutional theory has been focusing on metastructuring actions. Metastructuring actions are undertaken by the institutional elite, i.e., senior

management, as well as technology champions, and they include both direct actions to make the technology more valuable to users and indirect actions to manipulate prevailing institutional structures and influence individual structuring actions. For instance, Purvis et al. (2001) elaborate further on the metastructuring actions in the context of technology assimilation. Two actions were identified: the extent to which the CASE repository has been populated with relevant knowledge; and active championing and advocacy of the CASE platform by senior management. In addition, systems development methodology significantly influenced how users perceived the value and role of CASE technologies. Similarly Chatterjee et al. (2002) relied on institutional theory to identify three institutional factors: top management championship (belief and participation), strategic investment rationale and extent of coordination, for web assimilation (strategic and activity assimilation). Liang et al. (2007) investigated the institutional forces, i.e., coercive, mimetic, and normative, and the mediating role of top management in ERP assimilation. All the above studies, although insightful, sheds little light on how such organizational initiatives affect the individual behaviour and attitude in ERP assimilation.

ERP assimilation at the individual level can be considered as post-adoption behaviour with ERP systems. However, most prior studies have generally modelled the individual assimilation (explicitly or implicitly) as being influenced by the same set of factors that lead to acceptance and initial use, neglecting the unique nature of post-adoption behaviour with IT. For instance, some studies rely on technology acceptance model (TAM) or its extension to explain individual usage of ERP systems (Amoako-Gyampah 2007; Amoako-Gyampah and Salam 2004; Hsieh and Wang 2007; Shih 2006). Besides, IS Continuance (ISC) Model (Hsieh and Wang 2007), theory of reasoned action (TRA) (Bagchi et al. 2003) and Triandis framework (Chang et al. 2008) have also been explored in examining ERP assimilation at the individual level. Recently, Jasperson et al. (2005) reviewed the literature on post-adoption behaviour, identified the unique nature of post-adoption behaviour, and proposed a two-level

process model explaining individual post-adoption behaviour as influenced by organizational actions. In their conceptualization, post-adoption behaviour is composed of three components, i.e., feature adoption decision, feature usage, and feature extension behaviours. The first two behaviours can be either voluntary or mandatory; while feature extension behaviour is usually voluntary. Their extensive review indicates the dearth of research on post-adoption behaviour, and particularly the lack of theories explaining the dynamic interplay between the organizational action and individual cognition level.

Several conclusions can be drawn after examining existing research on ERP assimilation. First ERP assimilation can occur at many levels within an organization, e.g., strategic, activities, and individual. Focusing on one level will not provide a complete understanding of ERP assimilation. This requires a multiple level conceptualization of ERP assimilation itself. Second, despite a few studies which do provide insights on management initiatives to facilitate ERP assimilation, it is not clear that how such initiatives would unfold at the lower level and affect employees' behaviour and attitude. Thirdly, most prior research at the individual level, on the other hand, oversimplifies the contextual influences from the higher level. Therefore, to promote our understanding of ERP assimilation, it is important to adopt a multilevel approach to investigate the mechanisms for the rich interaction that occurs within systems of collective actions or metastructuring actions and shapes individuals' cognitive processing and cognitive content (Jasperson et al. 2005).

### **3 THEORETICAL DEVELOPMENT**

In this study, we adopt a multilevel approach in conceptualize ERP assimilation and identify empowerment as one important mechanism for the connecting organizational and individual cognitions. A multilevel model is then proposed to explain how organizational actions would interact with each other, influence individual cognitions and subsequent ERP assimilation.

#### **3.1 ERP Assimilation**



Adopting a multilevel approach, we conceptualize ERP assimilation at both organizational and individual levels. At the organizational level, we define ERP assimilation as the extent to which the use of technology diffuses across the organizational projects or work processes and becomes routinized in the activities of those projects and processes, in supporting, shaping and enabling firm's business strategies and value-chain activities (Armstrong and Sambamurthy 1999; Purvis et al. 2001). Due to its strategic and comprehensive nature, we also differentiate ERP assimilation in terms of strategic assimilation and activity assimilation (Armstrong and Sambamurthy 1999; Chatterjee et al. 2002). Strategic ERP assimilation means the utilization of the ERP system in company strategies; while process assimilation refers the application of ERP systems in supporting value-chain activities. At the individual level, we conceptualize ERP assimilation as post-adoption behaviour and define it as the myriad ERP feature adoption decisions, ERP feature use behaviours and ERP feature extension behaviours made by an individual user after ERP has been installed, made accessible to the user, and applied by the user in accomplishing his/her work activities (Jaspersen et al. 2005).

### **3.2 Empowerment**

Empowerment is a set of cognitions shaped by a work environment (Thomas and Velthouse 1990), reflecting the ongoing ebb and flow of people's perceptions about themselves in relation to their work environments (Bandura 1989). Some recent studies also explore empowerment at a higher level, e.g., work-unit level (Seibert et al. 2004) and team level (Kirkman and Rosen 1999). The introduction of enterprise information systems, e.g., ERP, will bring about high task interdependence and that will imply transformation of work tasks and services (Silva and Hirschheim 2007). Empowerment may offer a useful perspective to understand the changes in work environment due to ERP initiatives. Thus, we rely on empowerment theories to develop a multilevel research model explaining ERP assimilation within organizations.

At the individual level, psychological empowerment has been defined as an individual's experience of intrinsic motivation that is based on cognitions about him- or herself in relation to his or her work role (Spreitzer 1995). The overall psychological empowerment includes four distinct cognitions, e.g., meaning, competence, self-determination, and impact (Spreitzer 1995). Meaning involves a fit between the value of a work goal and a person's own values, beliefs and behaviours. Competence is an individual's belief in his or her capability to successfully perform work activity, or self-efficacy specific to work. Self-determination is a sense of choice about activities and work methods, reflecting autonomy over the initiation and continuation of work behaviour and processes. Impact is the degree to which a person can influence strategic administrative or operating outcomes at work. These four cognitions combine additively to form a single unitary construct; lack of any single dimension will decrease but not eliminate the overall degree of empowerment experienced (Spreitzer 1995). Prior studies indicate that psychological empowerment results not only some personality traits, e.g., self-esteem and locus of control, but also working context, e.g., access to information and reward system (Spreitzer 1995).

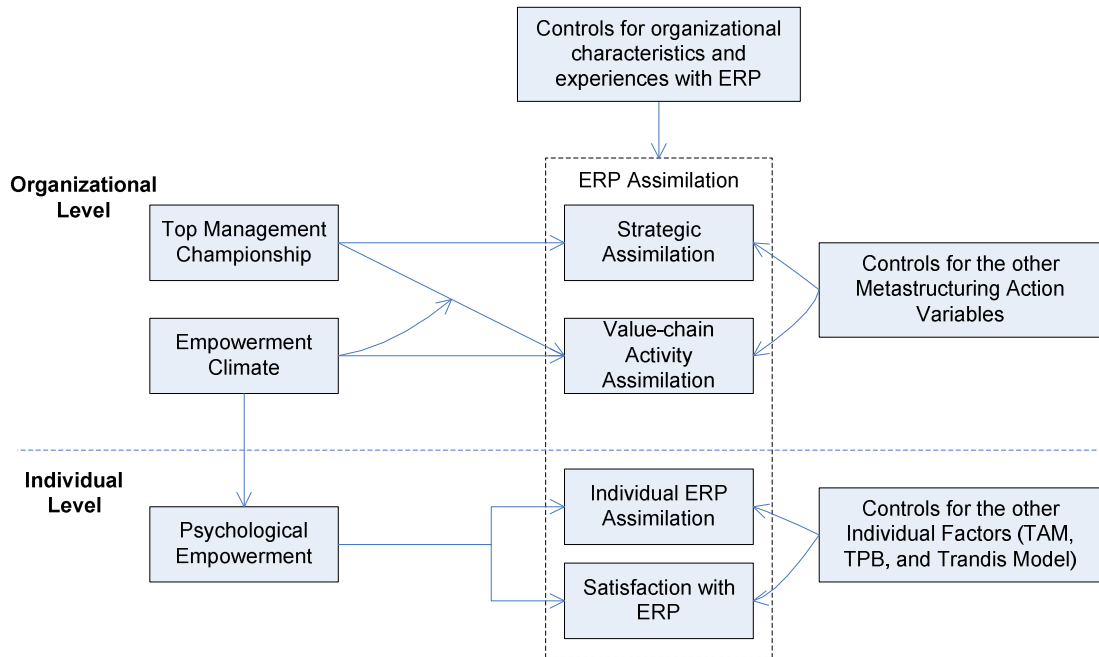
At a higher level, empowerment climate is defined as a shared perception regarding the extent to which an organization makes use of structures, policies, and practices supporting employee empowerment (Seibert et al. 2004). Different from psychological empowerment which anchors in "I" perception, the empowerment climate construct is designed to emphasize shared subjective experiences of empowerment (Seibert et al. 2004). Empowerment climate is composed of the three organizational actions identified in the previous literature, i.e., information sharing, autonomy through boundaries, and team accountability ((Blanchard et al. 1995) cf. (Seibert et al. 2004)). Information sharing means that employees have access to potentially sensitive organizational information, e.g., costs, productivity, quality, and financial performance. Autonomy through boundaries refers to organizational structures and practices that encourage autonomous action. Team

accountability represents a decentralized decision making structure, implying that teams are the locus of decision-making authority and performance accountability in organizations. Empowerment climate has been demonstrated to have direct influences on psychosocial empowerment and team performance (Kirkman and Rosen 1999; Seibert et al. 2004).

Although originally specified at the work unit level in (Seibert et al. 2004) and team level in (Kirkman and Rosen 1999), empowerment climate can also be extended to be organizational level. Particularly in the case of ERP assimilation, all working units within the organization have to be involved and therefore it is reasonable to expect a shared perception regarding the system application and diffusion. Thus, in this study, empowerment climate is conceptualized at the organizational level.

### **3.3 Research Model**

Drawing upon institutional theory and empowerment theories, we develop a multilevel model explaining ERP assimilation at different levels, i.e., strategic assimilation, value-chain activity assimilation and individual ERP assimilation, as well as individual satisfaction with ERP systems (see Figure 1). As the focus here is to illustrate the interplay between organizational level and individual level, only top management championship that has been demonstrated to be important for ERP assimilation (Chatterjee et al. 2002; Liang et al. 2007; Purvis et al. 2001) is selected while the other institutional factors are included as controls. Empowerment is conceptualized as the mechanism catalysing the influences from organizational level to individual employees. At the organizational level, empowerment climate not only has a positive effect on ERP assimilation in value-chain activities, but also serves as a contingency for the effect of top management championship on ERP assimilation in value-chain activities.



**Figure 1: A Multilevel Model of ERP Assimilation**

Similar to the prior research, top management championship is defined as managerial beliefs about ERP initiatives and participation in those initiatives (Barki and Hartwick 1989; Chatterjee et al. 2002; Jarvenpaa and Ives 1991). Top management offers the strategic rationale and visions regarding ERP initiatives, and produces norms and procedures of implementing ERP systems. Their strong belief and active participation in ERP initiative serve as a powerful signal for middle management and all employees to get involved and legitimate their effort. Prior research has demonstrated the important role of top management in facilitating Web assimilation (Chatterjee et al. 2002), CASE assimilation (Purvis et al. 2001) and more relevant, ERP assimilation (Liang et al. 2007). Consistent with existing studies, we propose:

*Proposition 1: Top management championship will positively influence extent of organizational assimilation of ERP in corporate strategies and value-chain activities.*

Empowerment climate, as discussed before, implies three main metastructuring actions, i.e., providing information access, encouraging autonomous actions, and authorizing work units for decision making and performance accountability. Previous research has documented the

positive relationship between empowerment climate and organizational and subunit performance outcomes (Seibert et al. 2004). In the context of ERP assimilation, this claim remains valid for following reasons. First, as the complex information system assimilation usually requires a lot of internal coordination and information sharing (Chatterjee et al. 2002), information access will guarantee the precision and consistence in implementing ERP to specific value-chain activities. Second, ERP assimilation also means extended features usage (Jasperson et al. 2005) and business process re-engineering (Venkatraman 1994), which requires re-define procedures, goals, and area responsibilities, which require an environment encouraging autonomy. This is also associated with the third component, that is, working units or teams corresponding to specific value-chain activities are empowered with decision making and performance accountability. Clear goals, responsibilities, and procedures facilitate effective teamwork, cohesion, coordination, and conflict resolution (Campion et al. 1993), leading to an effective ERP assimilation in value-chain activities. Therefore, we propose that:

*Proposition 2: Empowerment climate will be positively influence extent of organizational assimilation of ERP in value-chain activities.*

Empowerment climate implies power transfer from top management to work units or teams and consequently, the empowerment of employees, in a very real sense, creates the potential for control loss for the organization and management (Mills and Ungson 2003). Whole empowered departments may display incongruous behaviour and promote values and beliefs within their subunit for unequal exchanges (Mills and Ungson 2003). In the stage of ERP assimilation, we speculate that the effect of top management championship ERP assimilation may decrease as empowerment climate becomes significant and such an effect is more significant in ERP assimilation in value-chain activities.

*Proposition 3: Empowerment climate will negatively moderate the relationship between top management championship and extent of organizational assimilation of ERP in value-chain activities.*

Implementing ERP involves dramatic changes in job content, work goals, procedure and coordination. ERP assimilation at the individual level consists of ERP feature adoption, usage and extension, demanding a high level of competence and innovativeness. It has been widely supported that psychological empowerment will be related to individual effectiveness, innovative behaviour, and satisfaction (Liden et al. 2000; Seibert et al. 2004; Spreitzer 1995). The positive effect of psychological empowerment is argued to be held in ERP assimilation context as well. First, an empowered employee considers the value of a work goal fit with his/her own values, beliefs and behaviours. Rather than an external task enforced by the organization, ERP assimilation will be internalized to be his/her own goals. Such internalization is related to continuance usage (Dholakia et al. 2004). Secondly, an empowered employee also perceives a high level of self-efficacy specific to work, which has been demonstrated to be related to ERP post-adoption behaviour and satisfaction (Shih 2006). Thirdly, psychologically empowered employees enjoy a high level of autonomy over the initiation and continuation of work behaviour and processes, and therefore are more likely to extend the usage of ERP features. Finally, with an increased influence on strategic administrative or operating outcomes at work, an employee will feel more responsibility and accountability in ERP assimilation. Therefore, we propose that:

*Proposition 4a: Psychological empowerment will be positively related to individual ERP assimilation.*

*Proposition 4b: Psychological empowerment will be positively related to individual satisfaction with ERP.*

Empowerment theorists view psychological empowerment as the mechanism through which contextual factors influence individual attitudes and behaviours (Spreitzer 1995). According to (Seibert et al. 2004), empowerment climate represents an important contextual factor and its impact on individual attitudes and behaviours is mediated through psychological empowerment. Consistent with prior research, we also propose that:

*Proposition 5a: Psychological empowerment will mediate the relationship between empowerment climate and individual ERP assimilation.*

*Proposition 5b: Psychological empowerment will mediate the relationship between empowerment climate and individual satisfaction with ERP.*

#### **4 THEORETICAL AND PRACTICAL IMPLICATIONS**

Drawing upon Institutional theory and empowerment theories, we integrate macro and micro approaches to develop a multilevel model explaining ERP assimilation. The research model entails rich theoretical implications. First, by conceptualizing ERP assimilation at strategic, value-chain activities and individual level, this research integrates macro and micro approaches in understanding ERP assimilation. Second, this research represents the first attempt to develop a multilevel model explaining ERP assimilation. Such an approach offers rich insights regarding the driving forces for ERP assimilation at different levels. Thirdly, this research identifies empowerment climate as an important mechanism accounting for the interplay between organizational level and individual level in ERP assimilation. Finally, the moderating effect of empowerment climate highlights the interaction among metastructuring actions in influencing ERP assimilation.

Practically, this research highlights the importance of empowerment in ERP assimilation. Although top management strong belief and active participation are important for ERP assimilation, an overall success requires middle management and employees' internationalization, innovativeness and participation. It is therefore suggested to enhance

empowerment in ERP initiatives by using various means, e.g., training, individual-performance based reward systems, and decentralizing decision-making. In this way, lower level management and employees will be integrated with top management to form a unity for successful ERP assimilation.

This research has provided a clear venue for further empirical studies. Data from multiple sites will validate the effects of both metastructuring and individual variables on ERP assimilation, as well as the mechanism of empowerment in explaining the interplay metastructuring and individual actions. Moreover, based on this research model, further theoretical extension could be made on investigating the interplay between the other metastructuring actions, e.g., strategic rationale, coordination (Chatterjee et al. 2002), and individual factors, e.g., TAM variables. A longitudinal approach is also preferable to demonstrate the dynamics of various driving forces for ERP assimilation.

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