# Organizational learning and bureaucracy: an alternative view

Jonas A. Ingvaldsen and Vetle Engesbak
*Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Trondheim, Norway*

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## Abstract

**Purpose** – This paper aims to reconceptualize the relationship between organizational learning and bureaucracy. Although the two are generally considered to be antithetical, this paper shows that, in some organizations, bureaucracy can be functional for organizational learning.

**Design/methodology/approach** – The central argument is theoretical and builds on two main ideas: firstly, the nature of knowledge creation and organizational learning is conditioned by the organization's main technological characteristics; and secondly, bureaucracy has a dual nature as an instrument of managerial control and as a vehicle of large-scale collaboration. This study uses examples from process industries as empirical illustrations.

**Findings** – As products and production systems come to embody deeper and more diverse knowledge, their development takes on an increasingly collaborative character. The need to integrate differentiated knowledge and material artefacts calls for specialization, formalization, centralization and staff roles. Hence, technological complexity drives a bureaucratization of organizational learning.

**Research limitations/implications** – The core argument is developed with reference to industries where organizational learning involves the accumulation of knowledge, not its periodic replacement associated with technological shifts. Its relevance outside these industries remains to be assessed.

**Practical implications** – Organizations, whose knowledge creation fits the pattern of creative accumulation, should learn to harness formal structures for large-scale collaboration.

**Originality/value** – The main thesis runs counter to mainstream perspectives on organizational learning. This paper explores organizational learning in sectors that have received little attention in debates about organizational learning.

**Keywords** Innovation, Coordination, Organizational learning, Bureaucracy, Contradiction

**Paper type** Research paper

## Introduction

> [It] is sufficient to conclude that a bureaucratic system of organization is not only a system that does not correct its behaviour in view of errors; it is also *too rigid to adjust without crisis to the transformation that the accelerated evolution of industrial society makes more and more imperative*. (Crozier, 1964, p. 198, italics in original)

The Crozier quotation captures what continues to be the dominant view on the relationship between bureaucracy and organizational learning within management and organization studies: bureaucracy and organizational learning are antithetical to each other. A large body of literature argues that bureaucracies are poorly suited to the management of processes that are non-routine, experimental, uncertain or ambiguous (Donaldson, 2001; Raisch and Birkinshaw, 2008). These are exactly the key characteristics of learning processes that have

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the potential to generate significant innovations. Practical recommendations reflect these theoretical arguments: running through the prescriptive literature is the idea that learning is facilitated when individuals or groups are given leeway to experiment, free from bureaucratic constraints. The basic model of the "learning organization" is certainly not the Weberian bureaucracy of rational–legal authority and extensive formalization (Örtenblad, 2015).

If this view is accepted, the following puzzle arises: How do we make sense of organizational learning in industries where the bulk of innovations are carried out by a few incumbent firms who display all the core features – and supposedly rigidities – of bureaucracy, namely, centralization, formalization, standardization, functional differentiation and hierarchical control and accountability? Examples of such industries are chemicals, pharmaceuticals, natural resource extraction, primary metals and electronic components (Breschi *et al.*, 2000; Onufrey and Bergek, 2020). To argue that organizational learning within these industries is confined to exploitative process controls (Benner and Tushman, 2003) is incorrect, as these organizations devote significant resources to research and development (R&D) and continuously develop new technologies that raise the performance of operations (Lager *et al.*, 2013). An alternative account, according to which the learning takes place within specialized units with "a culture of autonomy and risk taking that could not exist in a large, centralized organization" (Tushman and O'Reilly, 1996, p. 25), is highly implausible, as the learning processes target highly interdependent and complex production systems, requiring a deep and contextual understanding of existing technologies and how they currently operate (Aylen, 2013; Onufrey and Bergek, 2020).

This article argues that the puzzle can be resolved only by reconsidering the relationship between organizational learning and bureaucracy. It does so by building on two core ideas. The first is that the nature of organizational learning within these industries is conditioned by the organizations' main technological characteristics and the forms of knowledge required to operate and develop those technologies (Ingvaldsen, 2015). The second idea is that bureaucracy has a dual nature (Adler, 2012), in that it is both an instrument of managerial control and a vehicle of large-scale collaboration. In brief, this article shows that the core features of bureaucracy – standardization and formalization, the authority hierarchy, specialization and staff groups – can be functional for organizational learning and even necessary to orchestrate large-scale learning processes that integrate diversified, highly specialized knowledge and involve substantial investment decisions.

By elaborating on these ideas, this article contributes a context-adapted understanding of the learning organization, which has recently been called for in this journal (Sitar and Škerlavaj, 2018; Örtenblad, 2015). Although developed with reference to a particular generalized organizational context, the argument challenges the often automatic, unreflective disdain for bureaucracy within organizational-learning discourse. Furthermore, this study suggests that bureaucratization – in a collaborative form – facilitates the "integrative ambidexterity" recently proposed by Cunha *et al.* (2019), in which exploitative and exploratory learning activities are synergistically related.

The main argument of the article is deductive and theoretical. To illustrate some of the key propositions, it draws on the authors' own empirical research from aluminium production, as well as on other studies from relevant sectors.

## Organizational learning and bureaucracy: the conventional view

Organizational learning "occurs when an organization's members revise their beliefs in ways that, when the beliefs are acted upon, improve the organization's performance" (Huber, 2019, p. 2). On the one hand, organizational learning is an emergent, on-going phenomenon driven by employees' practical experience, reflections on unanticipated events and socialization of new members (Gherardi, 2009). On the other hand, organizational learning is central to any attempt to improve organizations' performance deliberately, for example by introducing new technologies, realigning business strategy or making changes to administrative processes.

Unsurprisingly, then, management scholars have shown keen interest in how organizations can be designed to promote opportunities for organizational learning and harness learning for business purposes (Senge, 1990). A key theme running through this literature is that individuals and groups should be given leeway to experiment and challenge established ways of thinking and behaving. Supposedly, this is best supported by "organic" organizational structures (Örtenblad, 2015), which are decentralized and have low degrees of functional specialization and formalization (Donaldson, 2001). Hence, the image of the learning organization is often projected as the antithesis of that which brings stability and conformity to organizations: hierarchical control, standardization of processes, formalized divisions of labour and the like – in short, the bureaucracy.

As described by Weber (1968), the bureaucracy is an institution of impersonal, rational–legal authority. Public bureaucracies, staffed by disinterested professionals, are seen as a way to prevent arbitrary rule, and to ensure values of predictability, justice and equality (du Gay, 2000; Olsen, 2005). Within business organizations, bureaucracy remains the dominant organizational form for coordinating large-scale collective activity (Donaldson, 2001; Walton, 2005). Different authors list slightly different structural features of bureaucracy. We choose to build on Adler (2012, p. 246), who lists the following main features of bureaucracy: "extensive formalized and standardized procedures, complex structures of specialized roles and departments, differentiated vertical hierarchy and centralized policy making, and substantial staff departments".

The critique that bureaucracy stifles creativity and learning, and promotes risk-aversion, rigidity and conformity, predates the concepts of organizational learning and the learning organization (Crozier, 1964; Merton, 1940; Mises, 1944). Most famously, Schumpeter created the image of the heroic entrepreneur whose original ideas disrupt and destroy established business organizations (Schumpeter, 1983). Hence, from the outset, the creativity of the few on the outside was pitched against the conformity of the many on the inside of large, bureaucratic organizations.

These original critiques have been tempered in contemporary discourse, as it is widely recognized that much organizational learning takes place within bureaucratic organizations (Örtenblad, 2015). Bureaucratic features are even thought to support "exploitative" organizational learning, that is, learning that refines and fine-tunes existing knowledge and work processes (Sitar and Škerlavaj, 2018). Keum and See (2017) found that while the hierarchy of authority is detrimental to idea generation, it is beneficial for idea selection. Thereby, they extended an earlier idea that organizations may require organic structures to generate ideas, and bureaucratic structures to deploy those ideas (Raisch and Birkinshaw, 2008, p. 380).

Despite these more nuanced arguments, the notion that learning and innovation take place outside, and are constantly threatened by bureaucratic forms of organizing remains highly influential. It is echoed in practice-based approaches to organizational learning (Gherardi, 2009), and more influentially in literature on organizational ambidexterity (Raisch and Birkinshaw, 2008). A fundamental idea in the latter literature is that "exploratory" organizational learning – that is, learning that entails a shift away from current knowledge (Sitar and Škerlavaj, 2018) – should be separated in time or space from activities related to exploitative learning. Particular emphasis is put on the idea that management's desire for predictability and reliability – enacted through bureaucratic controls – tends to migrate to and suppress exploratory organizational learning, reducing organizations' capability for long-term adaption (Benner and Tushman, 2003). To facilitate innovation, large organizations are encouraged to establish separate organizational units, and therein foster "a culture of autonomy and risk taking that could not exist in a large, centralized organization" (Tushman and O'Reilly, 1996, p. 25). In other words, it is suggested that they emulate the internal conditions of the small entrepreneurial organization.

## Challenge to the conventional view

As Farrell and Morris (2013) noted, the study of supposedly dynamic and innovative organizations tends to draw attention to somewhat atypical sectors and organizations. Obvious examples are software companies that allegedly move towards radically de-centralized "self-managing organizations" (Lee and Edmondson, 2017). Turning attention to more prosaic organizations, such as those involved in large-scale manufacturing or chemical processes, the casual observer may be surprised to find how much formalization is apparently involved in their core innovative processes. Examples are the lengthy processes of testing and verification of new products and technologies in R&D-intensive organizations such as pharmaceutical companies (Ben-Menahem *et al.*, 2016) and advanced process industries (Lager *et al.*, 2013), or the extensive use, when launching new products, of formal controls to manage interdepartmental interdependencies within automotive manufacturing (Adler, 1995) or consumer goods (Craig, 1995). The assertion that these are sluggish organizations caught in an exploitative mode of learning fails to appreciate how much these organizations typically invest in R&D, reach out to external knowledge (be it that of suppliers or universities), improve their performance and innovate, often with respect to little-known, idiosyncratic technologies. An alternative interpretation – the one being developed here – is that these are indeed learning organizations, but the mode of learning is one in which bureaucratic features have been harnessed to orchestrate collective learning at a large scale.

The argument presented here extends to the organization level, the distinction made by evolutionary economists between Schumpeter Mark I and Schumpeter Mark II industries, and their associated patterns of knowledge creation (Breschi *et al.*, 2000; Fagerberg, 2003). The labels "Schumpeter Mark I" and "Schumpeter Mark II" refer to the ideas of innovation presented in Schumpeter's two main works, *The Theory of Economic Development* (1934) and *Capitalism, Socialism and Democracy* (1947), respectively. The latter work is a substantial revision of the former, in that the idea of the heroic entrepreneur is replaced by an idea that innovation could (and would) be routinized and even bureaucratized within large, monopolistic companies (Schumpeter, 2010, pp. 117-118). In contemporary treatments (Bergek *et al.*, 2013; Breschi *et al.*, 2000), innovation within the Mark I industries is thought to be characterized by "creative destruction", by which new knowledge and technology make the old obsolete. Examples of such dynamics are abundant in management literature [see Lucas and Goh (2009) for the case of Kodak]. By contrast, the Mark II industries are characterized by "creative accumulation", by which new knowledge builds on and is integrated with existing knowledge without replacing it.

The idea of "creative accumulation" as a distinctive pattern of knowledge creation and organizational learning has hardly been picked up within management and organization studies. However, by unpacking this idea on the organizational level of analysis, important insights are gained into why bureaucratic features can indeed be functional for organizational learning. In the subsequent sections, the argument proceeds in two main steps. Firstly, it will "bring in the forces of production" (Ingvaldsen, 2015) by showing how organizational learning in the Schumpeter Mark II industries is conditioned both by the organizations' main technological characteristics and by the forms of knowledge required to operate and develop those technologies. Here, the problem of innovation appears as one of coordinating highly specialized knowledge and learning processes on multiple levels. Hence, it requires large-scale collaborative efforts. Secondly, the argument builds on Adler (2012) to critically reassess bureaucracy as an instrument of large-scale collaboration. Taken together, the argument presented here is that the bureaucratization of organizational learning is a rational response to the collaboration needs created by the deepening and differentiation of technological and operational knowledge.

## Knowledge creation through creative accumulation

An organization's knowledge base is a combination of the organization's "body of understanding" and the organization's "body of practice" (Pavitt, 1998). While the former maps closely onto scientific or technological disciplines, the latter consists of company-specific knowledge about how to apply technological knowledge and artefacts to make products. Over time, organizations come to rely on an ever expanding body of understanding, reflecting the general progress of science and technology in society (Ingvaldsen, 2015). This development drives a specialization of knowledge within the company and within R&D functions specifically (Pavitt, 1998). Simultaneously, more advanced production processes and products tend to embody knowledge from different scientific disciplines and areas of expertise. This also drives a specialization within the body of practice, in that employees specialize in different products and production processes. Taken together, when knowledge accumulates, it also diversifies and specializes organizational units.

Extreme examples of such developments are found in mature process plants that exploit production technology with low modularity. Modularity refers to "the degree to which a system's components can be separated and recombined" (Schilling, 2000, p. 312). In such plants, each technological component may embody the latest advances in, for example, mechanical, electrical or chemical engineering, but the different components constrain each other through physical or chemical relationships and must be carefully engineered to fit together along multiple dimensions. The typical technological innovations in these plants involve "stretching" the existing system's performance by adding or replacing individual components (Aylen, 2013). In such processes, the capability to integrate existing and new technologies becomes key. Iansiti (1995) showed that successful technology integration is linked to a broad approach to organizational learning, which merges deep technological understanding with a detailed understanding of the operational environment into which the technology is being integrated.

### *Example: process plants in Multinational Aluminium*

To illustrate the main characteristics of knowledge creation in these industries, Multinational Aluminium (MNA, a pseudonym) can be considered. Like other primary aluminium producers, MNA's plants exploit an updated version of the Hall–Héroult electrolysis process, invented in the 1880s. While the basic technological principles remain stable, significant performance improvements have been made over the years, and new fields of knowledge have come to complement the old. Operation of a modern aluminium plant requires capabilities within diverse fields, such as material science, electrochemistry, electrical power engineering, thermodynamics, computer science and mathematical simulations. With the specialization in knowledge has come the functional differentiation of MNA's R&D function.

MNA's production systems have low modularity, usually because of thermodynamic relationships. The replacement or addition of a component at one place in the system, or the calibration of operational parameters, can have far-reaching and unpredictable consequences, often appearing with significant time delays. The temporal dimension, in particular, can complicate experimentation, as it can be hard to determine exactly which modification caused a specific intended or unintended consequence. In one innovation project studied as part of this research, an old lubricant was to be replaced by a proprietary new lubricant based on different technological principles. The implementation required the plant to risk one week of production in the cast house while performing the experiment. The project group included managers and operators at the cast house, as well as R&D personnel with different specializations. The decision to scrap the new technology was made one year after implementation, but this decision was then reversed two weeks after that because a solution had eventually been found for several unexpected operational problems caused by the new lubricant. This highlights the risk and costs associated with experimentation, but also the challenges associated with testing new technologies in an operational environment.

## Organizational learning and bureaucracy: an alternative view

The previous sections suggest that the forms of organizational learning associated with the development of complex, interdependent technological systems require large-scale collaboration among various specialists. Three distinct but related coordination challenges confront the learning processes:

- Coordination of different disciplines of science and engineering within the R&D function. This reflects how products and processes come to embody knowledge that is more diverse.
- Coordination between operations and R&D. This relates to the integration of specific components, but also to the short- and long-term alignment of multiple plants' technological needs and R&D priorities.
- Coordination of resources for testing and investing in new technology. This reflects the capital-intensive nature of the production in question.

In light of these challenges, the conventional coordination mechanisms associated with organizational learning appear inadequate. Based on structural contingency theory, it is expected that the R&D function is organized relatively organically, compared to operations (Donaldson, 2001), because the former engages in exploratory learning. Within the R&D function, organic forms of coordination may be sufficient, even though formalization and hierarchy have been found to benefit learning even at the team level (Bunderson and Boumgarden, 2010). However, organic forms of coordination scale poorly beyond the team level and are unreliable for making consistent long-term decisions (Barki and Pinsonneault, 2005).

Separating in time and space exploratory and exploitative learning activities and integrating them only at the top-management level (Benner and Tushman, 2003) run counter to the requisite integration of operations and R&D essential to technology integration (Iansiti, 1995; Jansen *et al.*, 2009). As Tyre and Orlikowski (1994, p. 99) demonstrated, introduction of new technology in operations "is a complex, recursive process, involving 'mutual adaption' of both the new technology and the existing organization, and requiring the active cooperation of both users and technology developers". If these processes are left unmanaged, operations tend to develop a practice that routinizes workarounds and fails to realize the potential of the new technology (Ingvaldsen, 2015). Development, in turn, will tend to modify the technology based on wrong assumptions about actual use. Attempts to tackle these coordination challenges through marketization of R&D and decentralization of investment decisions have generally proven unsatisfactory (Hill *et al.*, 2000). Marketization encourages short-termism and opportunism, and contracts are poor at governing the uncertainty and equivocality of technology integration (Coombs, 1996).

While conventional perspectives on organizational learning would not appreciate bureaucratization as a viable response to these coordination challenges, Adler (2012) showed that these perspectives have a limited understanding of the nature and functions of bureaucracy. Notwithstanding that bureaucracies are instruments of domination for managerial elites (typically pursuing short-term financial goals), they are also vehicles for large-scale collaborative efforts. Furthermore, the collaborative functions are not restricted to routine activities (e.g. large-scale production), but extend to non-routine actives, such as knowledge creation and organizational learning. In Adler's (2012) treatment, a basic contradiction runs through bureaucracy, in that it is simultaneously an instrument of managerial coercion and an enabler of large-scale collaboration. Which feature is predominant for a particular organization is contingent on a wide range of social and economic factors (Adler, 2015; Adler and Borys, 1996). For the industries in question, the argument of this paper contends that the technological characteristics, together with competitive pressures, promote the collaborative features, as they support the forms of learning required for technological innovations.

Concerning coordination between R&D and operations, a broad range of media-rich integrating mechanisms is required to address task uncertainties and local contingencies (Van de Ven *et al.*, 1976). Formalization and standardization make this collaboration more reliable and predictable. Mutual expectations and the division of labour between the two departments can be clarified and reflected upon (Ingvaldsen, 2015). Standards may codify scientifically sound methods for testing and validating technologies. Similarly, the company may adopt proven practices to assess and balance technological risk (e.g. portfolio management). Specialist staff roles, liaisons or the like may act as translators or routers of information between departments, for example in finding the right expert to aid operations when an ill-defined, unforeseen problem related to technology integration is encountered.

Solutions to coordinating investments highlight other features of bureaucracy: centralization and legal-rational authority. Decisions on funding technology development and investments in industry-scale application of new technology will likely be politically contested, as the future of plants, workplaces and managerial careers may be at stake. As shown by Hill *et al.* (2000), decisions on capital expenditure tend to be highly centralized in R&D-intensive companies. The legitimacy of investment decisions depends on their transparency and rationality with respect to explicitly defined technological and economic criteria. The fusion of competency and decision-making power is central to Weber's concept of legal–rational authority (Höpfl, 2006). Decisions based on legal–rational authority do not exclude broad participation, as the decision criteria may be collectively defined (Adler, 2012). Furthermore, hierarchical authority mitigates actors' bias towards promoting and selecting their own ideas (Keum and See, 2017).

Table 1 summarizes the argument with respect to bureaucracy's main features, contrasting the results with the conventional view. This paper's argument highlights the collaborative features of bureaucracy. However, these features co-exist with a strong tendency to turn formal power against knowledge creation and organizational learning (Adler, 2012). Financialized capitalism (Thompson, 2003) may incentivize management to use their authority to suppress innovative activities altogether in favour of intensified exploitation of the firms' current resources. Trends of delayering and increasing job

Table 1.
Bureaucracy and organizational learning revised

| Features of bureaucracy | Conventional view (detrimental to learning) | Alternative view (functional for learning) |
|---|---|---|
| Specialization | Hampers collaboration | Deepening of knowledge |
| Formalization and standardization | Compliance replaces creativity. Prevent experimentation | Create predictable and reliable relations between different departments. Make knowledge accessible, independently of individual employees |
| Hierarchy and legal–rational authority | Cumbersome and slow decision-making | Rational allocation of capital investments and risk. Objective evaluation of ideas |
| Staff | Involvement of staff cripples local autonomy, creativity and experimentation | Staff aid business units in integrating new technology and best practice. Maintains a network of meta-knowledge (who knows what) within the organizations |

**Note:** Features based on Adler (2012)

insecurity for middle managers (Hassard *et al.*, 2011) may reinforce this short-term mindset. Corporate governance based on economic results may not encourage knowledge sharing, but rather create a competitive environment where each business unit keeps innovations to itself. Decentralization, which often goes hand in hand with tightened financial accountability, will likely lead to uncoordinated technology decisions across business units, disregarding scale advantages of R&D investments.

*Example: organizational learning in Multinational Aluminium*

*Specialization.* To operate the aluminium plants and to increase their efficiency through continued organizational learning, MNA uses people with backgrounds ranging from vocationally trained operators of different specialities to engineers and PhDs in material science, electrochemistry, electrical power engineering, thermodynamics, computer science, mathematical simulations and more. In operations, the specialization supports the exploitation and fine-tuning of existing work processes and technological systems. Within the R&D function, specialization is necessary to access and deepen knowledge of the multiple domains of science and technology that the company uses. For many of MNA's technological processes, only highly specialized personnel may comprehend the theoretical foundations. The R&D units also manage relations with research institutions to absorb knowledge generated outside of MNA, and sometimes the units take part in that knowledge creation through joint projects. As such, specialization supports both exploitative learning (in operations) and explorative learning (in the R&D units).

*Formalization and standardization.* MNA's production processes are tightly controlled and monitored through extensive use of standardized work practices, documentation of work performed and deviations measured. Deviations are systematically tracked and fed into a process whereby work processes are revised (Ingvaldsen *et al.*, 2013).

Beyond this exploitative learning in operations, the process controls are important to technology integration. Because of the low modularity of the production systems, changes in hardware and software components may have unintended consequences, which show up at unexpected places in the process and at significant delay. Being able to pinpoint effects and correctly attribute changes in outcomes to changes in technology are, therefore, both challenging and crucial. It also allows different technological components to be benchmarked against each other, often over long periods to determine long-term effects. According to an R&D manager, extensive process control is, therefore, a prerequisite to successful innovation ("step change"):

> [It's] all about delivering stable and robust processes, developing stable and robust processes that are controllable, and manage to do continuous improvement on top, and then step change on top of that again. That's what drives [an increase in productivity].

Formalization and standardization also enter the earlier phases of technology development, testing and verification. For instance, the cathodes used in the electrolytic cells represent high capital investments and have an expected lifetime of seven years. As such, experimenting with the design of these entails a significant amount of risk-taking. Reliable and standardized technology verification methodologies reduce the risks of experiments, provide long-term direction for technology R&D, help with resource allocation across multiple potential projects and create predictable interfaces between R&D and operations. Technology testing and verification are planned in the yearly "technology-roadmap process" that involves individual plants, the R&D department and the central management. During the process, concrete plans are made for individual technologies and plants for the following year, and 5-year and 10-year plans are updated.

*Hierarchy and legal–rational authority.* The hierarchy of authority is beneficial for idea selection (Keum and See, 2017). At MNA, this applies to the fine-tuning of existing work processes, but even more importantly, to allocate risks and rewards rationally when making investment decisions. New technologies, all of which eventually need to be verified in the actual production line, inevitably carry with them risk. In many cases, the expected upside, evaluated against the consequence of failure, is so low that it is not a good business decision for a single plant to implement a new technology before it has been further verified (preferably at another plant). According to MNA, the ability to effectively mitigate this risk, and continuously qualify and implement new technology, depends on a centralized system for negotiating and decision-making, balancing risks and rewards between multiple plants. MNA attempts to make these decisions according to objective-rational criteria, but they can be highly unpopular at individual plants.

*Staff.* Staff in MNA distil and spread new knowledge about both new technologies and the operations of current technologies. Special liaison roles are spread throughout MNA to create reliable linkages both among plants and between the plants and R&D units. They serve as contact points and coordinate learning activities. For example, the roles ensure that the R&D units have an overview of the problems facing operations, and they help to resolve process variation that occurs during and after technology implementation.

MNA also maintain formal systems that help operational units with locating and integrating relevant knowledge across the organization. One example is the Core Teams programme, where employees in similar roles across different locations and R&D representatives come together for cross-locational learning [see Engesbak and Ingvaldsen (2019) for further discussion of this programme]. A department manager from one of the plants describes its benefits:

> The Core Teams make us able to extract the benefits of being a large organization, and learn across units. So, we don't have to stand here alone as a single operation and try to solve everything ourselves; we can make use of the competence both of the [R&D] units and of the other operational units.

## Discussion and conclusion

The main purpose of this article has been to revise the widely held view that bureaucracy is antithetical to organizational learning. Contrary to that view, this study shows that when knowledge develops through creative accumulation, bureaucracy can be functional for organizational learning. This argument has implications for both theory and practice.

### *Theoretical implications and future research directions*

The results of this study contribute to theory by developing two related themes currently receiving attention in the literature on organizational learning. The first main theme is the relationship between organizational learning and formal organizational structures, what Örtenblad (2015) calls "learning structure". While prior treatments have argued that formal structures primarily constrain organizational learning, this paper has shown that formal structures may also facilitate organizational learning. The conflicting conclusions can be reconciled if it is presumed that we are dealing with different context-adapted modes of the learning organization. The Schumpeter Mark II industries, with their associated pattern of knowledge creation, would then be a "generalized organizational context" (Örtenblad, 2015), giving rise to a distinct pattern of organizational learning in which bureaucratic features are functional.

An alternative and complementary interpretation of the conflicting conclusions is that they follow from different foci and framing of the key phenomenon. If organizational learning is seen as an extension of creative processes at the individual or group level (Argote and Miron-Spektor, 2011), then formal structures are likely to appear as constraints. If, however, organizational learning is seen as a large-scale collective process (Ingvaldsen, 2015), then formal structures appear as necessary instruments of collaboration. As organizational learning is driven by multiple interests and happens at multiple levels (Field, 2019; Kilskar *et al.*, 2018), both foci remain useful. The levels might even be integrated if bureaucratic features are thought of as providing an overall structure, within which more organic forms of collaboration can emerge. Similar ideas, relating to formal and informal mechanisms of coordination, have been proposed within literature on knowledge creation (Ben-Menahem *et al.*, 2016) and contingency theory (Donaldson, 2001, p. 94), and these ideas may also be fruitfully put to use in discussions of learning structure.

The second main theme to which this article contributes is organizational ambidexterity. The findings on the requisite integration between operations and R&D in technology integration clearly run counter to the literature's emphasis on structural separation (Benner and Tushman, 2003). Rather, the argument presented here joins, among others, Jansen *et al.* (2009) and Cunha *et al.* (2019) in calling for stronger multi-level integration of exploratory and exploitative learning, at least for the industries discussed in this article. The findings from MNA may even be interpreted as an instance of "integrative ambidexterity", in which exploitation and exploration are aligned synergistically in a single mode of learning (Cunha *et al.*, 2019). At MNA, extensive process controls – associated with exploitation – produce input for exploratory activities and are preconditions for reliable testing and verification of new technological concepts and artefacts. Likewise, new technologies, when implemented, support better exploitation and are fine-tuned with the help of process controls. Hence, exploitation in operations and exploration in R&D appear to inform, rather than to contradict or compete with, each other.

This article has two main limitations. Firstly, the argument is theoretical and deductive. Hence, the main propositions need to be tested for empirical validity. Specifically, it hypothesizes that organizations within Schumpeter Mark II industries show a higher level of bureaucratic features governing their learning processes, compared to organizations outside these industries [see Donaldson (2001) for measures of bureaucratic features]. The second limitation of this article is the relative emphasis put on bureaucracy's collaborative function, compared to its coercive function. In practice, the functions co-exist. Looking ahead, an important theoretical challenge is to account for both the contradictory nature of organizational learning (Cunha *et al.*, 2019) and the contradictory nature of formal organizational structures (Adler, 2012) simultaneously. Contingency models may shed light on when the enabling or constraining features of bureaucracy become more salient, and what forms of learning are indeed facilitated or constrained. Power and interests (Field, 2019) are likely to be key variables, as they determine what purpose the bureaucratic apparatus is set up to serve (Perrow, 1972).

*Practical implications*

Researchers and practitioners should abandon the idea that bureaucracy and organizational learning are essentially antithetical. Instead, they should explore when and how bureaucratic features can support the desired forms of organizational learning. In particular, organizations whose knowledge creation fits the pattern of creative accumulation should learn to harness formal structures for large-scale collaboration. Rather than replicating the internal conditions of small entrepreneurial organizations, their challenge is to build better bureaucracies of reliable collaboration between interdependent specialists.

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**Corresponding author**
Jonas A. Ingvaldsen can be contacted at: jonas.a.ingvaldsen@ntnu.no