Modeling Microfoundations for Organizational Strategy

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ABSTRACT

There have been repeated calls for a microfoundational (reductive) account of organizational strategy, echoing the macro-micro phenomena first identified by Chester Barnard. This paper responds to those calls by creating an account of individual agency, defined as *caused action*, for members of a firm that constitute nested localized work groups. The work groups are constituents of functional divisions which constitute the firm *qua* system. The activities of the system are likewise constituted by actions/processes at the divisional level and the work group actions/processes nest within the divisional processes. Aggregation upward from the work groups to the system level is not emergent; the aggregation is governed by the firm strategy and other process functions at the system level. Thus, individual intentionality and action are supported by what cognitive science calls scaffolding. In our model the salient scaffolding is the organizational strategy, though we also note the importance of organizational identity and authority structure. We include in the analysis two relevant accounts of group agency from the literature on social ontology which serve as individual- and group-level foundations for the model. We extend this micro view to the system level through *mechanistic explanation* drawn from the cognitive and natural sciences. The mechanistic model is dynamized to allow for updating strategy purposefully and in the manner of Mintzberg and Water's incorporation of emergent strategies. We relate the dynamic mechanistic model to the dynamic capabilities approach. Finally, we offer a formalized version of this model as a basis for strategy simulations and case studies.

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Introduction

Interest in microfoundations, or efforts to unify micro-level with macro-level factors within multi-level collectives, emerged within management roughly two decades ago and remains live, spanning multiple sub-disciplines including the fields of management, strategy and organizational theory (Barney & Felin, 2013; Felin et al., 2012; Gavetti et al., 2012). The broad question of what microfoundations are as well as the project of constructing a fuller microfoundational account have spurred considerable discussion within both organizational theory and strategic management, prompting repeated calls for a microfoundational account of organizational strategy. These calls have been framed from both a cross-disciplinary vantage, blending strategy with organizational theory (Abell, Felin & Foss, 2008; Barney & Felin, 2013; Felin & Foss, 2011; Felin, Foss & Ployhart, 2015) while others have focused upon strategy more exclusively (Felin & Foss, 2005; Foss & Lindenberg, 2013; Vromen, 2011).

While the repeated calls for accounts of microfoundations signal considerable scholarly interest in further advancing this discussion beyond the mere identification of theoretical need, the number of calls for microfoundations have far outstripped the accounts proffered. While this work has been formative in working out a conceptual definition of microfoundations, demonstrating their inter-conceptual relevance and underscoring the need for fuller accounts, comparatively little has been done to build them. This discussion risks stagnation unless efforts at nascent theory building are undertaken to repair this gap. This lacuna owes to many factors but the following two are salient enough to merit mention. First, perhaps owing to the disciplinary pluralism surrounding the issue, the question of how to define microfoundations remains an open one. This definitional opaqueness has resulted in a diversity of conflicting claims, often serving to spur the proliferation of half-truths pertaining to what microfoundations are and are not (Barney & Felin, 2013). Second, microfoundational theorists who assume either a reductive or aggregative account of interlevel relationships must reckon with what we term ‘the problem of scalability.’ Specifically, the question facing such theorists is ‘how does individual cognition scale to

collective behavior?' (Powell et al., 2011: 1374). The problem, illustrated in brief, is as follows. For any collective, if collective behavior requires awareness of individual members regarding other members' cognitive states (e.g. intentions, beliefs and so on), the cognitive demands on individual members quickly surpass the limits of bounded rationality once the collective increases beyond a fairly small size (Simon, 1957). Reductionists and aggregationists alike then face the decidedly grim prospect of constructing only microfoundational accounts which are cognitively implausible for non-omniscient, human subjects. Indeed, this issue concerning scalability from the micro-level as well as other misconceptions about the implications of methodological individualism for the microfoundations project has invited close scrutiny (Hodgson, 2012; Jepperson & Meyer, 2011).

We seek to address and resolve this problem by providing a fully reductive account for the microfoundations of strategy via the construction of a conceptual, formal model. This model builds upon previous work which takes a mechanistic approach to aggregation/scalability (Vromen, 2011). Yet this model constitutes a novel contribution to the literature in representing a fully reductive microfoundational account which both resolves the scalability problem and additionally satisfies the following four desiderata which we jointly take to be crucial for a successful microfoundational account of strategy. (1) It must be built upon *agency*, so as to link individual or small group action to collective (firm-level) action. In this, we hold agency to be *caused action* (Anscombe 1957, Bratman 1987, Davidson 2001, Tuomela, 1997). It is critical that the organizational strategy be front-and-center as *causal* to collective action and to individual action. The latter is a minimal requirement for a microfoundational account of strategy – explaining what Abell, Felin & Foss (2008) depict as "downward causation" from the firm level. (2) The account must show the *mechanisms* that aggregate individual intentionality and action; it is insufficient to <u>solely</u> rely upon *emergence* of collective mental states from individual minds (Vromen, 2011). Essentially, recourse to emergence represents the foundation of a fully holistic model of strategy which is orthogonal to a microfoundational account. Specifically, we depart from the approach of Felin, Foss, & Ployhart (2015), who use the phrase *mechanisms for emergence*. We separate mechanisms from emergence as the former makes explicit the constitutive and causal relations between group members (and

their actions) and the actions of larger aggregates such as the SBU or firm. What cannot be made explicit as a mechanism remains an emergent property of the group. (3) The account must have a dynamical structure to permit strategy to evolve and adapt over time in response to internal and external causal forces (Eisenhardt, Furr & Bingham, 2010; Eisenhardt & Martin, 2000). We construct this account to serve the specific desideratum such that both planned and unplanned strategy (Mintzberg & Waters 1985) can be admitted. (4) The account should be amenable to extant and influential accounts of firm-level organization theory and strategy. We explicitly link the model presented herein to the dynamic capabilities approach (Teece, Pisano & Shuen 1997; Teece and Heaton 2015) and by extension, to the resource-based view of firm (Barney 2001; Mahoney & Pandian 1992).

This paper advances and contributes to the literature in the following ways. First, the fully reductive microfoundational account described by the conceptual model represents an attempt to engage in nascent theory building for bridging the chasm between calls for attention to the microfoundations of strategy and a fully formed account of the microfoundations of strategy. This contribution is aimed at moving the issue of microfoundations forward so as to avoid stagnancy. Specifically, the model is potentially generative of propositions for further development and empirical testing, facilitating a transition from theory to future qualitative and quantitative empirical research. This represents an important attempt to forge a link between purely conceptual theorizing and empirical research on the issue of microfoundations. Additionally, we bring new theoretical tools to bear in solving the scalability problem. To wit, (1) we draw on social ontology for aggregating mental states which are antecedent and causal to collective action; (2) we introduce a construct from evolutionary theory that serves to mitigate the scalability problems due to bounded rationality – an "external memory" called scaffolding; and (3) we build upon the Coleman bathtub as a model for multi-level theorizing with a recent development in philosophy of science called the New Mechanistic Explanation. These innovative tools respond directly to a challenge by Felin, Foss, and Ployhart (2015, p. 617) which gestures towards the use of recent work in social ontology which concerns issues such as collective action, agency and intentionality (Tuomela, 2007; List & Petit, 2011).

By more specifically typologizing the generative, multi-level mechanisms which serve to span the micro and macro-levels as well as incorporating micro-level cognitive states into the scalability scheme, we seek to achieve a microfoundational account which answers criticisms regarding the conceptual ambiguity of microfoundations (Hodgson, 2012); criticisms concerning the temporal dynamics and origins of capabilities (Winter, 2011); as well as criticisms which identify social complexity as a barrier to aggregative accounts which are microfoundational in nature (Jepperson & Meyer, 2011). Regarding the final issue, our contribution lends support to the response that complexity does not pose an irreconcilable issue for aggregative accounts which are either rooted in assumptions of methodological individualism or which presuppose microfoundations (Abell, Felin & Foss, 2014).

Second, we translate a graphico-verbal account of microfoundations into our formal model. We use the formal model to highlight how our microfoundational account relates to two mainstream accounts of strategy. The first is the Mintzberg and Waters (1985) account of planned and unplanned strategy that leads to realized strategy. We show how explicit modeling at the work group level permits the strategy process to authorize collective strategic action at the micro-level and allows the strategy process to evaluate and codify localized activities for inclusion in subsequent strategy. The second touchstone is the dynamic capabilities literature (and by implication, the resource-based view). Our formal model, as well as the verbal account, focuses on the human and organizational resources while pushing physical resources to the background. This is the consequence of responding to the past literature on microfoundations which is mostly occupied with "individuals and their interactions". We believe that addressing these two touchstones and making the constituent and causal relationships clear at the firm-, divisional-, and work group-levels in both the graphico-verbal and formal models points the strategy community to creating case studies and simulation models that will pay off in operationalizing a microfoundational approach with explanatory power.

This paper proceeds as follows. First, we investigate the limits of a wholly individualistic account of collective action. We use a well-known formal model of small group cooperation (Bratman 2014) based on a commonly accepted account of methodological individualism, wherein group-level intentions

and actions rely solely on the facts about the individual group members and their interactions. We make the interactions explicit with regard to what all group members know about all other members' intentions for group action. We identify the limitations of such modeling approaches, limitations which are captured in our description of the scalability problem. Second, we introduce a new representation of nested (multi-level) mechanistic systems that we claim is superior to the Coleman bathtub -- an alternative model for inter-level reduction -- for locating strategic processes within complex firms. We argue that this approach known as the New Mechanistic Explanation (Bechtel & Richardson 2010; Glennan 2017, Glennan & Illari 2018) makes both the constitutive structure of organizations and the causal relationships within mechanisms in the constituent groups clearer both from explanatory and ontological perspectives.
In the third section of the paper, we address what Barney & Felin (2013) call the *sine qua non* of microfoundations: "how individual-level factors aggregate to the collective level" (p. 145). This is the messy landscape of where reductive and holistic accounts of organizational phenomena, like strategy, compete for explanatory relevance. As we noted above, this is where the capacity for mechanistic explanation competes with reliance on non-specific emergence in accounts of organization-level phenomena.

In the fourth section, we introduce a dynamic model of system development (adaptation, change) that contributes a solution to Barney & Felin's (2013) aggregation problem and models the causal relations between firm-level strategy and meso- and micro-level action. In addition, it makes explicit two mechanisms for altering/updating firm-level strategy: as a reaction to external events and as a reaction to what Mintzberg & Waters (1985) called unplanned or emergent strategy[1]. The model is derived from Wimsatt (2014) and exploits a construct called scaffolding. Scaffolding represents some conceptual representation external to the individual human mind that is available to members of a collective with access to that representation.

[1] This use of the term emergent is not homologous to the way it is used in discussing non-mechanistic processes elsewhere in the paper. We will make the process explicit and mechanistic.

In the fifth section of the paper, we integrate the scaffolded model with the (nested) mechanistic model in a graphico-verbal account of the microfoundations of strategy. We augment this verbal model with a formal model of the constituency relationships from the firm- or system-level through a meso-level (e.g. divisions) to the work groups that constitute the divisions. The formal model makes clear the mechanisms for creating novel candidate activities for incorporation into subsequent strategy à la Mintzberg and Waters (1985) and for causing action by the work groups. Inferences from the formal model are drawn for explaining dynamic capabilities as represented by the human and organizational resources that are the salient features of a microfoundational account: the individuals and their relationships (within the strategic framework). Moreover, the shared intentionality and firm-specific scaffolding that we use to construct this model are the microfoundations of the strategic assets that Barney (2001) describes as promoting inimitability of a chosen strategy: social complexity and path dependence. The paper concludes with a modest recapitulation and discussion of reasons and methods for extending the model in future research. The proposed extensions manifest in the presentation of several propositions which may serve as a springboard for future empirical work which can carry forward the project of providing a fully reductive account of the microfoundations of strategy.

The Organization as a Purposive Collective of Individuals

One can describe the outcome of human activity in collective agency as unplanned or emergent, and planned. The ability to discern and interpret whether the members of an organization are acting jointly, following a plan toward a collectively held goal and coordinating their actions with regard to other group members, or acting as individuals with wholly emergent collective outcomes, is critical to theoretical and empirical research in management. Is the group acting jointly, for a common goal? Are each of the members acting as individuals with individually-held goals but coordinated in their actions? Are the individuals acting as individual agents without regard to others' actions and goals? If one answers "yes" to the first question, this is a paradigmatically cooperative activity. If one answers "yes" to the second, it implies that other-regarding behaviors are in place with the possibility that all group members

share mutual understanding that when the group members act in coordination, everyone achieves their individual goals. If the third question is answered affirmatively, we see simply summative – mob-like -- activity. Everyone in the park runs to the shelter from a thunderstorm; no planning occurred, just a common collective outcome.

Chester Barnard (1938) was the first organizational scholar to be concerned with how organizational performance (efficiency and effectiveness) was caused by how individual organization members' goals and actions are aligned with the collective's goals and purposes. Barnard was a committed methodological individualist. Barnard is quoted in the microfoundations literature, as "the individual is always the basic strategic factor of organization" (Felin, Foss, and Ployhart (2015); Felin, Foss, Heimeriks, and Madsen 2012). Yet the bulk of Barnard's *Functions of the Executive* is concerned with how organizational structure and leadership expand the degree to which joint activity – Barnard's *cooperation* – supplants individual motives and actions as the significant element of organizational development. We follow Barnard's lead in relying on philosophy to aid our theorizing.

We start from an individual-level construct: *agency*, defined as *caused action* (Anscombe 1957, Bratman 1987, Davidson 2001, Tuomela 1977). The intention to act is conditioned or motivated by beliefs and desires of the individual. How do we get from individual intentionality – which includes the relevant mental states of belief and desire, as well as intention to act – to collective agency? Collective agency consists of both collective intentionality and collective (caused) action. The latter is visible. We can see a project team design and produce a prototype. Group intentionality is not visible. Are the project team members operating with joint beliefs and goals or are they acting for their own reasons? Does it matter as long as the prototype is completed on time?

We believe it does matter. If there is truly a microfoundational account of strategy, there must be explicit links between organizational strategy (both process and content) and the intentions that cause action. If the links are not made, then we are left with some emergent phenomenon, i.e. the strategy is summative of individual intentions and actions; or that there is some clearly articulated causal relationship

between the organizational strategy and individual actions that substitutes for individual mental states such as belief, judgment, and intention. Both of these counterfactuals are unsatisfactory for explanation. We begin with our reasoning that there is no wholly individualistic account of organizational strategy. That is, the strong-form stance on individualism is that all relevant facts of a group can be described by the facts of the individual group members and the relations between them (Kincaid 1996, Udehn 2001). This is a modest conflation of two philosophical stances: ontological individualism and explanatory individualism. The former implies that there are no higher-level facts about the group that exist beyond individual intentions and actions and the mental states that are shared in a network sense between the group members. Thus, by-laws and other rules that describe the constitution of the group or set boundaries on duties, responsibilities, and actions are not within the ontology. The latter stance is that explanation of group actions is privileged at the individual level, since there is no "group mind" and all action is undertaken by individuals. Epstein (2009, 2015) cautions that we must be skeptical of both ontological individualism and explanatory individualism even in simpler human groups than formal organizations like corporations

Consider an individualistic account that has much traction in small group social ontology (Bratman 1999, 2014). Bratman's "modest sociality" requires that all members $\{g_1, g_2, \ldots g_n\}$ of group G have a jointly held intention to do a collective action J with an apparatus of meshing sub-plans that are necessary to do J. The compact form of this account is as follows.

> A group G jointly intends to (do) J IFF for all $g_i \in G, g_i$ intends that G (do) J and g_i intends that G (do) J in accordance with, and because of, meshing subplans associated with the intention of each member of G that G (do) J.

While this statement appears redundant, there are eight sufficient conditions that Bratman holds for shared intention (Bratman 2014).

1. all members of G intend that we J;
2. intentions for all g_i to do J are joined by way of mutual responsiveness in intention and action;
3. individual intentions are joined in the joint intention to do J by way of meshing sub- plans for each g_i;
4. all members of G believe that individual intentions of each g_i persist, and that each will perform their part to do J, by way of (2) and (3);

5. the beliefs of each member g_i that intentions to do J by way of (1) are interdependent with the beliefs of all other members of G;
6. the intentions of each member g_i are persistence interdependent with the intentions of all other members of G;
7. common knowledge of all conditions (1) – (7) exist for all members of G; and
8. mutual responsiveness in sub-intention (sub-plan for each g_i) and individual actions connects shared intention (1) – (7) to do J with the joint action.

While this account looks overwrought, it fully relates the coordination and cooperation required to take individually-held intentions to achieve a group outcome J. Mutual recognition of the individual sub-intentions, their sub-plans, and the necessity that they mesh to achieve J through the joint plan, are not sufficient if there is no expectation of each group member's persistence of belief and action. This allows that we do not have formal obligations or promises (e.g. contracts) to perform for each member. Instead, a "modest sociality" exists that is sufficient to explain small group behavior around a mutually agreed plan. One can easily see the merits of this account for modeling small organizational groups for whom knowledge and intention are shared and transparent. Such groups would include work teams and entrepreneurial start-ups. And certainly this account has the benefit that the planning apparatus is familiar to strategy scholars.

As Westgren (2021) notes, this account cannot scale up effectively by adding more members to Group G and assuming that *all* the mutual recognition, knowledge of others' actions, and individually held beliefs in *all* others' persistence can be held by *all* group members as the group membership increases. The cognitive load for individuals *qua* group members would violate our understanding of bounded rationality. This limitation is exacerbated by the problem of large organizations – the multiplicity of groups, whose varied activities (agency) creates additional complexity beyond simply adding organizational members. There must be some external cognitive apparatus that is available to the group. Cognitive scientists call this *scaffolding*. We define this below and point to organizational strategy as such an apparatus – not as a substitute for individualistic (microfoundational) intentionality, but as a complement.

Beyond I-intentionality

There is one step between Bratman's full-on individualistic account of intentionality and a micro-foundational model of strategy. Tuomela (2013) has an account of collective action based upon *we-intentionality*, a mental state that is shared by group members that is not reduced to individual intentionality or *I-intentionality*. Supporting the existence is shared ethos and a strong sense of shared identity (Westgren and Foreman 2021). Tuomela requires three criteria to we-mode cooperation: group reason, a collectivity condition, and collective commitment to act. Group reason, or team reason, has been supported by decision theorists such as Bachrach (2006), Sugden (1993, 2003), and Gold & Sugden (2007). Moreover, Foss & Lindenberg (2013) rely on this in their discussions of team motivation and team production. The collectivity condition requires that satisfaction of the group goal (as in Bratman's "we do J") *necessarily* satisfies each group member's goals for engaging in the collective action. Thus, we do not need some summative account of individual goals for action within the group *pace* Bratman. Collective commitment is entailed by joint intention and is related to shared ethos and shared identity (Whetten 2006, Ashforth & Mael 1996). Identification with the group or team has been shown to lead to commitment to the organization's goals (Mael & Ashforth 1992, Riketta 2005).

We can see how a formal statement of the Tuomela account (2013, p. 68) compares to the Bratman account above. If we accept that group reason, the collectivity condition, and collective commitment exist in Group H, then the account of we-intention for a small group of equal-status members is as follows.

1. Each individual h_i in Group H is functioning *qua* member of H;
2. the intention for each h_i presupposes that all h_i collectively accept J as their intention to satisfy the goals of H;
3. each h_i intends to participate in the satisfaction of J; and
4. each h_i presupposes that the central we-mode criteria are satisfied for all h_i.

It appears that Tuomela's account of we-intentions is less complex than Bratman's account of shared I-intentions. This is due in large part to the explanatory "lifting" of the we-mode criteria that establish group reason, group commitment to action, and the sufficiency of the group goal J as the collective goal

orientation for all members. The cognitive load implied by the Tuomela account is less than that for the Bratman account, but clearly there is still an expectation that shared ethos, group reason, and commitment to group goals and group action[2] will remain subject to bounded rationality as the organization size and structural complexity increases.

There remains one element of Tuomela's small group we-intentionality – as distinct from all other accounts of small group ontology we have seen – that serves the microfoundations of strategy project. His 2013 account explicitly considers authority and hierarchy with respect to cooperation, both I-mode (coordination among individuals that may hold individual goals) and we-mode (full-on cooperation). A key to Tuomela's argument is to what degree his three critical elements of we-intentionality are met or *approximated* under external (hierarchical) authority: the collectivity principle, collective commitment, and (perhaps authoritative) group reason. One actually observes more than *approximate* we-intentionality with the existence of strong identification with the group – firm, unit, or work team (Tuomela 2013, p. 176) and the member's identification with the organizational identity (Westgren & Foreman 2021).
We believe that the Tuomela account of we-intentionality serves as a microfoundation to strategic management and to organization theory, as Felin, Foss, and Ployhart speculate (2015, p. 617). We argue in this paper that we-intentionality exists in work groups or teams and the requisite cognitive load for group/team members doesn't violate bounded rationality for their agency in their part of the organizational collective. We build upon his in the next section where we "locate" such group agency within the organization.

Mechanistic (Multi-level) Explanation

The microfoundations project in strategy reviewed above (Abell, Felin, & Foss 2008; Felin & Barney 2013, Felin, Foss, & Ployhart 2015, Foss & Lindenberg 2013,) implies a mechanistic explanation; that is, what are the micro-level mechanisms that aggregate to a firm-level depiction of collective action? Alas, much of the discourse has relied on a meso-theoretical model of social action

[2] Shared ethos, commitment to group (collective) goals and group reason (supported by active leadership) are critical to Barnard's (1938) theory of organizational efficiency.

nicknamed the Coleman bathtub (c.f. Abell, Felin, & Foss 2008) from James Coleman's (1980) account of Weber's model of Protestant doctrine and capitalism shown as Figure 1 below. The leftmost panel is the seminal Coleman representation. On the right is the generalized representation of micro/macro social phenomenon from Abell, Felin, and Foss (2008), which is seminal to the microfoundations literature.

Place Figure 1 about here

Coleman's approach is an interesting form of methodological individualism that attempts to marry rational choice at the individual level with social structural explanations at the macro level. One may carry the argument forward as to whether the horizontal arrow linking macro-level antecedents (religious doctrine for Coleman) and macro-level outcomes (capitalism) becomes redundant when the micro-level is specified (religious doctrine $\rightarrow$ individual values $\rightarrow$ economic behavior $\rightarrow$ capitalism) and thus, dispensable. Coleman argues that it is not dispensable, but microfundamentalists would disagree. We maintain that both the macro-macro causal relation and the macro-micro-micro-macro causal chain provide valuable explanatory power for strategy modeling. This is consistent with prior work on multilevel modeling in strategy (Felin, Foss, Heimeriks, and Madsen 2012; Felin, Foss, and Ployhart 2015).

This section of our paper explicitly considers this epistemological issue. We begin with Vromen's (2010) response to Abell, Felin, and Foss (2008). Then we present a modern form of mechanistic explanation that is superior to the Coleman bathtub. Vromen (2010) argues that the diagonal arrows in the Coleman bathtub are "shorthands" for the true nature of causal explanation in multi-level models. That is, he "squares" the diagram by stating that the micro-level causation occurs in parallel with arrow 4 in Figure 2. The explanation is that the micro-level phenomena are *constituents* of the macro-level phenomena representing the end points of arrow 4. So, if there are macro-level antecedents, they cause the macro-level outcomes. They do not cause (or condition) the micro-level phenomena. There are

constituent antecedents (line 5) and constituent outcomes (line 8), which are linked by the causal relationship(s) between the end points of the micro-level.

Place Figure 2 about here

Vromen bases his analysis upon the definition of mechanistic explanation of Machamer, Darden, and Craver (2000) and Craver and Bechtel (2007), wherein there are no allowable downward causes and, since macro phenomena are the aggregations of (constituent) micro-phenomena, there are no upward causes. Causal relationships occur only within a given level. Vromen's rebuttal to Abell *et al* is valid if all mechanistic explanations have the same characteristic structure as that of Craver and Bechtel (2007) and if Abell *et al* insist that their version of causal explanation is mechanistic, as they do in their reply to Vromen (Abell, Felin, and Foss 2010). In this reply, they assert that there are downward and upward causes (lines 1 and 3 in Figure 2). That is, they do not accept the Vromen definition of mechanism. To resolve this ontological issue we elaborate the new mechanistic approach to explanation to which Vromen alludes and demonstrate its superiority to the Coleman bathtub.

Machamer, Darden and Craver (2000) introduce an elaborated account of mechanistic explanation. This version of mechanistic explanation derives from the physical sciences (hence, mechanistic), wherein the relationships between the whole and the parts in a system are most clearly constituent. On this kind of explanation, a *mechanism* is a causal system in which the organized parts collectively give rise to the behavior or property of the whole (Craver & Bechtel, 2007). There are two elements of a mechanism: entities or objects, and actions. In a physical system there are linked objects such as gears, cogs, levers, switches, motors, etc. These are causally actuated between the initiation action and the final output. One sees, hears, or otherwise senses the hidden mechanisms between tapping their credit card and picking up a cold drink from a vending machine. The vending machine is the system, the whole. There is an electronic mechanism that takes as input information from the credit card chip and has

an output of initiating a physical/mechanical process that selects, moves, and delivers the drink outside the system.

In a social system, the entities are humans and human groups. Their actions are the individual and collective decidings, creatings, and transformings of inputs. The use of present participles highlights the human actions and not just the outputs (decisions, creations, …). However, the outputs are the mechanistic linkages between one entity and the next in a mechanistic causal chain.

Additionally, it is worth explicitly defining how levels are to be understood on this kind of model. An entity X is *at a lower level* than an entity Y *if and only if* X is a component in the mechanism for some action of Y. X is a component in a mechanism *if and only if* it is one of the entities or activities organized such that the purpose of Y is fulfilled. This is made clear in the graphical representation in Figure 3 of a generic firm in the style commonly known in the new mechanistic explanation literature as a Craver diagram, named for Carl Craver who devised it with his colleagues (cf. Craver 2007, Craver, Glennan, and Povich 2021; Craver and Bechtel 2007, Povich and Craver 2018). Figure 3 depicts an organization. The topmost oval represents the system (firm) which receives inputs and delivers outputs beyond the organization boundary (i.e. the can of soda from the vending machine). These outputs are measurable for the purposes of assessing performance of the organization (physical, economic, and strategic). The middle oval identifies that there are four divisions in the organization that act as mechanisms between the inputs and the outputs. The actions and outputs of division D1 and the actions and outputs from divisions D2 and D3 are causal and temporal inputs to division D4. Divisions D2 and D3 have bilateral linkages that may be feedback links or parallel unilateral input-output links. The third oval is a magnified representation of division D2, with five identified work groups that are constituents of the D2 mechanism. Each of the work groups is itself a mechanism of entities (group members, teams) and their actions that are causally linked to one (W1, W3, W4) or two (W2) of the other constituent work groups that comprise D2.

Place Figure 3 about here

We see in the magnified representation that D2 receives inputs from D3 and sends outputs to D3 and D4, though the exact causal chain from D3 through the five work groups is tacit, as it was in the middle representation of the divisional structure within the organization. If we were empirically modeling the microfoundational structure of a firm, all the input-output relationships that affect system performance would be specified.

In Figure 3, the lowest level of disaggregation of the system whole is the work group level. Should the explanandum of the research require disaggregation of the work teams to the member individuals, then we would add another layer of magnification showing the constituent members and their linkages. Reasons for going to the individual level might include examining acculturalization of new members, defections, and joint experience levels as causes for team, division, and organizational performance (Harrison and Carroll 1991, 2006; Carroll and Harrison 1998). One may also examine individual and collective learning when modeling organizational learning as a component of strategic advantage (March 1991; Child 2001; Arthur and Huntley 2005; Butler and Grahovac 2012).

We shall now consider what the conceptual advantages of the addition of the new mechanistic model for debates about inter-level causation are.[3] In the mechanistic model, the relationship between levels is a constitutive one. Per the mechanistic model, a higher level is composed by and thus contains or is 'constituted' by its respective lower-level parts, activities and organizational scheme. This makes inter-level causation in both directions (either top-down or bottom-up) implausible for at least two reasons: first, constituency violates the 'non-overlap' condition (i.e., the prescription that causes not overlap with their respective effects and vice versa); and second, supposed interlevel 'causes and effects' thus co-occur synchronically, thereby violating the prescription that causes temporally precede their effects.

These two points are briefly explained as follows. First, a commonly accepted requirement for causal relations to hold is that the operative cause and its respective effect do not overlap or that they be

[3] The following points, which deal with the implications that the constituency relation portends for causation, exclusively address the issues of inter-level causation. They do not apply to the issue of intra-level causation which is perfectly accessible and assessable on a mechanistic model.

independent of one another (Lewis, 2000). However, in inter-level relationships, the macro-level is composed of or constituted by a given set of micro-level activities and components. Hence, attempts to frame interlevel relationships as inclusive of downward causation would involve positing 'causes' which are composed of or contain their 'effect.' This is clear in the following example: "The bowl is brittle *in virtue of* the weak ionic bonds which constitute the bowl's atomic structure" (Tahko, 2016). In this case, the macro-level property or 'brittleness' is constituted by or composed of the weak molecular bonds at the micro-level. The wholes and parts thus overlap in multi-level mechanisms. To claim that the bowl's brittleness 'causes' the bowl's weak ionic bonds would be tantamount to advancing a causal claim wherein the 'cause', in this case, the bowl's brittleness, ontologically implies its very 'effect' or the micro-level molecular composition. Similarly, a piece of matter's being gold does not cause it to have 79 protons. Second, to echo a point made by Vromen (2011), the constitutive relationship between levels is capable of being represented synchronically whereas causation is a diachronic property (Lewis, 2000). Given that the macro-level is composed of or constituted by the lower-level phenomenon, a synchronic snapshot can be rendered to capture the interlevel relationship since, in multi-level mechanisms, the macro-level phenomenon is composed by the given micro-level parts and activities. However, per most theorists, causes must temporally precede their given effects. Thus, interlevel causation is largely ruled out on the multi-level mechanistic account since both: (1) parts and wholes clearly overlap; and (2) interlevel relationships admit of a synchronic representation whereas causation is exclusively a diachronic property.

We shall argue that this model represents a promising expansion upon Coleman's bathtub model in two ways: (1) it better captures the true nature of explanatory levels; and (2) It elucidates the issue of decomposability in complex models. Moreover, this new mechanistic template demonstrates that emergence is a *limit condition* (Bechtel and Richardson 2010, p. xlvii). That is, what cannot be explained using mechanisms (causal relations) remains mysterious and cannot be used either as an *explanans* for firm-level phenomena, nor serve as an *explanandum* for either a firm-level or constituent-level process.

The true nature of explanatory levels: In the mechanistic model, the relationship between levels is constitutive rather than causal. This model is also an improvement on aggregative models which take the property of the whole to be nothing more than the sum of the properties of its parts. Mechanisms are, contrariwise, more than the sum of their parts. When removal of some components is sufficient to occasion change, mechanisms change non-linearly. Notice that the removal of parts at the lower level will not always generate higher level change given the possibility of redundant components and activities at lower levels; e.g. removal of one kidney is often not sufficient for renal failure in humans. This reflects a greater complexity —namely, it properly accounts for spatial, temporal and hierarchical complexity— which better accords with the nature of the phenomena (firms) we are interested in modeling. This model also lends clarity to the issue of the potential dispensability of intermediate and macro-levels, contra the micro-fundamentalists, by outlining in greater relief what precisely is taking place at each level. This model thus serves as an expansion and further refinement of the formative bathtub models presented earlier.

Decomposability: Mechanistic models permit us to detect decomposability more aptly than the bathtub models presented earlier since they make room for greater spatial, temporal and hierarchical complexity. With respect to the implications this has for management, there is a different perspective on multi-level causes and complex organizations that informs the nature of the methodology of microfoundations in organizations, especially with respect to strategy. The call for elaborating the microfoundations of organizational strategy presupposes that the organization can be decomposed into either discrete units or discrete processes. These discrete components of the strategic whole can be modeled as phenomena for the purposes of explaining organization-level behaviors as outcomes of micro-level behaviors. Many of these phenomena are characterized as mechanisms (see Felin & Foss 2005; Abell, Felin & Foss 2008, 2009; Vromen 2010, 2011). However, the degree to which the organization can be decomposed constrains the identification of mechanisms and the consequent explanation. This decomposability constraint is thus made clearer on a mechanistic model.

In the next section of the paper, we consider the most difficult task in response to Barney and Felin's (2013) statement that aggregation is the *sine qua non* of a microfoundational account of organizational strategy. Given that we have shown above that simple summative aggregation of individual agency cannot occur in large groups or complex formal organizations like corporations, there must be something that substitutes for common knowledge[4] held in the individual minds to achieve scalability.

Strategy as Scaffolding of Micro-level Intentionality and Action

Several recent papers in evolutionary biology, cultural evolution, and human cognition/learning and the interstices among them have used the concept of scaffolding as a metaphor for the active interfaces between externalist and internalist perspectives in evolutionary and adaptive processes. We draw upon a recent book, *Developing Scaffolds in Evolution, Culture and Cognition* (Caporael, Griesemer, & Wimsatt 2014). Caporael *et al* take a catholic approach to definitions of scaffolds; they may be temporary, but they may be long-lived to the point of assimilation into the boundary between the environment and the focal development process—biological evolution, cultural change, or individual cognition/learning. Scaffolds are analogous to tools that humans use in performing tasks. A vivid example is the smart phone appended to nearly all young adults. It serves as a computer, map, communication tool between them, and an external memory (images, songs, mathematical formulae) and other cues readily accessible for immediate cognitive processes. For prior generations, the scaffolds were reference books and atlases in the school or public library, landlines, and bulletin boards. Across the generations, groups of humans constructed scaffolds they might collectively use as external memory. Beyond physical scaffolds including printed documents, there are scaffolds for comportment: group or tribal norms, parables and fables, indoctrinations, and oral history. The key shared characteristic of these human scaffolds is that they are purposively constructed artifacts of collective action.

[4] The authors are grateful for an anonymous reviewer who cautioned that common knowledge as it is conceived in game theoretic reasoning is highly limiting and would fatally constrain any account of sociality. We respond with new thinking in the cognitive sciences that recognizes *scaffolding* as an aid to human cognition that exists outside individual minds but is available to individuals who know of it without literally knowing it.

Linnda Caporael (2014) highlights group behaviors in epistemic projects that serve as an interface between individuals and their habitats (biological or cultural). These serves as scaffolding for large group coordination. This form of scaffolding has been developed by cognitive scientists and others interested in collective action. Gordon and Theiner (2015) state that "routines and capabilities are built out of capacities for shared – both joint and collective – intentionality that enable individuals to engage in complex forms of collaboration in conjunction with multiple layers of scaffolds that encompass material and symbolic resources, social processes, and cultural norms and practices" (p. 154). The importance of epistemic action by collectives (creating identity, image, norms, and shared culture and decisions) is further supported by Theiner (2014) and Sterelny (2010). Theiner and Sterelny argue that one is not seeking to model group collective action as the result of a group mind, but to marry social ontology and we-intentionality with cognitive scaffolds that ameliorate the aggregation problem as stated by Barney and Felin (2013).

William Wimsatt is a senior scholar in evolutionary theorizing. Wimsatt (2014) continues his theorizing in evolutionary modeling to include cultural evolution. He uses Figure 4 to illustrate the role scaffolding plays in a multi-stage organizational or cultural development process. In this figure, the scaffolds appear as intermediation between the focal developmental process (i.e. organism/organization growth and organizational change) and the wider environment. Some scaffolds, particularly in the early stages of development are caused by agency external to the focal process. (We refer to the focal process as development of the organization from this point.) The first scaffold element in developmental time could well be purposeful construction of initial firm strategy, which then causes behaviors in the initial stage that carry forward across internal events through time. Wimsatt calls this *early-stage scaffolding*, with a decaying causal effect unless there is active feedback from the internal events to *entrench* the scaffolding. One can see the "outward" causation from internal events that are evidence of potential entrenchments.

Place Figure 4 about here

At this juncture, we replace Wimsatt and Shank's generic development stages and scaffolds with the specifics of strategic management of an organization through time. The generic vertical ovals representing developmental stages in Figure 4 are replaced by ovals representing system-level processes in the Craver diagram (Figure 3) with the nested mechanism levels suppressed for visual clarity.

The Nested Mechanistic Model with Scaffolding through Time

In Figure 5 below, we replace Wimsatt and Shank's generic system-level processes with firm-level strategic action (as depicted in Figure 3) in the development stages of the organization at seven discrete time periods labeled T1 through T7. Each stage is operating under strategy S^t with the requisite physical capital, human resources, and organizational resources[5] deployed at time *t*. The entities at the system level and the relationships that connect them across space and through (strategy) time will be at the firm level. At every strategy stage S^t (*t*= 1,2,3...5) there will exist constituent mechanistic entities and processes that express the devolution of the firm collective into constituent divisional, departmental, and work team nested levels. The precise representation of the strategy connections to the nested entities will be developed below.

Place Figure 5 about here

Consider that each vertical oval in Figure 5 is the middle depiction of the divisions within the organizational system from Figure 3. Each of the seven system representations in the seven time periods represents the whole of the organization with the embedded divisions made explicit. For the purposes of exposition, the number and array of the divisions changes over time; T1 looks exactly like the representation in Figure 3, but over time we see six divisions (T2, T3, T4), four divisions (T5), and seven

[5] In the paper we characterize the relationships between our micro-foundational model and the dynamic capabilities approach. In short, our model serves as an explanatory representation of these two system-level strategy models with primary focus on the human resources, social processes, and organizational structure with physical resources in the background.

divisions (T6, T7). As well, the causal chains connecting the divisions change along with their number. These changes occur after the instantiation of a new scaffold – the strategy.

In Figure 5, the first strategy state S^1 (left-most) shows that the founding strategy is in place and effectively governs agency in the firm. The action of the strategy as a scaffold directing action within the firm is the curved arrow from S1 to T1.

The strategy that we have modeled as scaffolding describes both a process-oriented view of strategy and a content-oriented view. Figure 6 below makes this clear. In Panel A of Figure 6 we observe the incidence of the initiating strategy S1. Some parts of the articulated strategy are localized as causal inputs (initiating, governing, controlling, etc.) to particular divisions (lines 1 and 2). The remainder of S1 would be articulated elements of the strategy that causally affect the whole organization. This can be considered as both strategy content (what the relevant articulated elements are) and strategy process (serving as scaffolding to all the micro entities).

Place Figure 6 about here

Returning to Figure 5, the strategy is re-formulated in the second strategy state S^2, caused by an external event in the business environment (a triangle) and by group action in one of the divisions, as depicted by the causal (dashed) arrow to the second scaffolded strategy. The same group-level action by the division causes a structural change in the entities and processes in S^2 (follow the two dotted lines linking one entity in T1 with two entities in T2). One observes three subsequent strategy revisions over the development of the firm, the last driven by an external event (e.g. a competitive move) and the other two by agency within the organization structure and constituent processes. These two agentic revisions of the strategy are initiated within the firm at T3 and T4 and are represented by dashed arrows from the initiating divisions to the revised strategy, S3 and S4 respectively.

Therefore, the strategy *qua* scaffolding informs intentions and constrains actions by individuals and groups within the firm that are fulfilling their constituent functions within the firm structure. This is the most basic function that defines system (firm) strategy as it is understood in the field of management.

One important element of our model is the strategic management process that alters the extant strategy by intentional collective action by the top management team with some shared intentionality with other individuals and groups within the organization. This is the specified constituent mechanism for updating the strategy prior to the next strategy state S^j in the development time dimension in Figure 5. It may reflect decisions to build dynamic capabilities that will scaffold firm processes in future strategic stages. It may also reflect incorporation of Mintzberg and Waters' (1985) unplanned strategies (entrepreneurial, ideological, umbrella, and imposed). The desiderata of a complete microfoundational account of strategy must include strategies that are mandated, authorized, accepted (after experimentation or serendipity) and have the necessary mechanisms articulated that cause or permit unplanned strategic choice as well as planned. We elaborate these desiderata more fully in the next section.

From a Verbal Account to a Formal Account

The foregoing verbal account of the model has limited explanatory power. We might improve upon this with a series of elaborate graphical representations (following Bechtel and Richardson 2010). We believe that the most effective means to show the nested levels of organizational agency as they relate to the strategy scaffolding, especially as strategy is devolved to mechanistic levels and consists of planned and unplanned strategic action through time, is with a formal model. Our formal model consists of (1) micro-level accounts of work group agency that follow the Tuomela we-intentionality design, (2) explicit constituent relations between work groups and aggregates (i.e. higher levels), (3) explicit constituent behaviors/processes that link constituent entities that can also be aggregated, (4) the points in constituent behaviors/processes where strategy scaffolding conditions or controls agency, (5) mechanisms where unplanned actions are permitted by the strategy scaffolding (and where they are not), and (6) mechanisms where unplanned strategies and planned changes to extant strategy (e.g. building dynamic capabilities) are accepted at the S^T level and become valid for S^{T+1}.

S^T represents the whole firm containing the resources (physical asset resources, human resources, financial resources, and organizational resources) and the processes that transform inputs to the firm into

outputs (products and services). In this model, we suppress physical and financial resources to highlight the human dimensions of the firm that are front-and-center in the microfoundations literature: human resources as well as the social (interpersonal and collective) resources that have agency within the firm and represent what Barney and Felin (2013) identify as the *sine qua non* of the microfoundations project -- the aggregation/scalability of individual-level "factors" to the collective level.

We begin with a description of organizational entity constituent relationships. There are three nested levels.

(a) S is the system level, the bounded organization.

(b) D^j (j = 1, 2, ..., r) are divisions (functional/structural) of S.

(c) w_l^j (j = 1, 2, ..., r; l = 1, 2, ..., s) work groups constitute the divisions;

superscripts denote the division and subscripts, the constituent work group.

There are two concepts of time used in the formal account.

(a) At any identifiable point in time, t, the members of S are countable and their actions are visible at all three nested levels.

(b) We define strategic time T to describe a time period where a single strategy exists for all of S. The strategy is known by all members of S at time T and is referred to as $STRAT^T$. Thus a history of S will contain some number, n, of strategic times ($STRAT^1$, $STRAT^2$,..., $STRAT^n$) in episodic order. This conforms to the vertical developmental stages in Figure 5.

(c) In each strategic time T, there will be discernable periods, t, such that T = 1 is $(t_1, t_2, \ldots, t_n) \in T = 1$.

The Micro-level

Each work group w_l^j has m_l members who share we-intentionality to complete tasks that are bounded by the strategy in place for time period T. The we-intentionality is derived from shared identity

for w_l^j members, group reason, the collectivity condition, and a collective commitment to act as a group, subject to STRAT^T .

However, at all points in time governed by a given strategy, $\forall t \in T$, there are operative and nonoperative members of w_l^j with respect to some action *At,* which is intentional. This is important in defining the true nature of constitutive actions within S. We refer to the diagrams in Figure 6, which depict constitutive relationships between the entities ("who") and the processes ("what") that describe mechanisms of agency at the nested levels. In the social ontology literature, notably Tuomela (2013), Ludwig (2016), and List and Pettit (2011), the distinction of which agents are operational (active) in a given process is critical. Without this distinction, a microfoundational account is incomplete.

Formally, we start with a single action at time *t*, *At.* All members of the work group *w* at time *t* are operative, OP, or nonoperative, NON for *At.*

$$\forall\, x \text{ member } \in\ w_l^j \text{ at time } t\,, x\ \in\ \{A_t OP\} \text{ or } x\ \in\ \{A_t NON\}.$$

At any time t, any work group w_l^j may have more than one activity using group resources, say A_t^1 and A_t^2. It follows from above that all members of w_l^j will belong to one of three subsets of work group members: $\{A_t^1 OP\}, \{A_t^2 OP\},$ or $\{A_t NON\}$.

In the we-intentional formal organization, all members are acting jointly with group reason and shared intentionality-in-action in STRAT^T. At any time $t \in T$, some members will be operative agents in some activities that comprise the visible actions $\{ A_t^1\, OP, A_t^2\, OP, \ldots, A_t^n\ OP\}$ and the remaining members will be $x\ \in\ \{A_t NON\}$. As the duration of *t* increases, the size of the set $x\ \in\ \{A_t NON\}$ goes to 0. This is the nature of the formal organization.

In the formal organization with joint goals and group intentionality-in-action, we need to express a mental state for nonoperative members with respect to all activities in which they are not active: *acceptance*. In Tuomela (2013, pp. 163-4) the general form of intentional group action (IGA) is as follows.

(IGA) Group G brought about and action or state A intentionally (or, saw to it that A was the case) as a group in the social and normative circumstances C IFF in C there were specific authorized operative agents ($x_1, x_2, ..., x_m$) for action in G such that
(i) ($x_1, x_2, ..., x_m$), when acting qua group members intentionally together brought about A (i.e. there was some action Y such that these operative agents intentionally brought about Y and this performance of Y generated A, and was correctly believed and intended by the operative members of G), or respectively, these agents saw to it that A;
(ii) because of (i), the (full-fledged and adequately informed) nonoperative members of G, as members of G, tacitly accepted the operative agents' intentional bringing about (or seeing to it that) A; and
(iii) there was mutual belief in G that (i) and (ii) prior to action.

Translate these conditions from the general group G to the micro-level of the model, where we have the members of the work group explicitly identified: $\{x_1,x_2,x_3,\ldots,x_m\}$ are members $\in$ w_l^j at time t. Their agency is guided and constrained by STRAT^T, including the subset of w_l^j that did operational activity $\{A_t OP\}$.

"Aggregating Up"

There are several elements of Tuomela's account that affect our development of a microfoundational account of strategy. First, there may be members of the organization with formal authority (more on this later) *to see to it that* actions occur. Second, Tuomela doesn't require all members of the organization to have knowledge of which members are operative in doing Y so as to bring about A. Third, all members of a formal organization accept the existence and intentionality of work groups with operational members at any time *t* because of three components of the formal organization (what Tuomela calls social and normative circumstances C above): *authority structure*; *authorization* of A_t (i.e. which members are operative for the bringing about of some A at time *t*); and shared understanding of *membership* in the group -- for Tuomela (2013), this is G. For our model, this is, at a minimum, understanding the membership of the relevant work group w_l^j responsible for action A_t, but can be easily extended through our understanding of social identity to both the division D^j and the firm S. These represent three forms of scaffolding which support Barney and Felin's (2013) "aggregation" of individual intentionality and action.

In our formal model of the microfoundations of strategy we make two elements of Tuomela's generalized "social and normative circumstances" explicit. The first is the *authority structure* (AUTH) that is common to management theory and organigrams. The second is the *authorization* of the activities (A_t^i), which we consider to be STRAT^T. Both of these constructs will be explicit in the formal model. Tuomela's third circumstance is the nested *organizational identity*. As we are concerned with developing a microfoundational model of strategy in this paper, we will omit identity in this account. Nonetheless, we believe that the three forms of scaffolding are not mutually exclusive and that the degree to which they are mutually reinforcing for guiding collective agency in the organization is critical to its performance. We do retain a*uthorization* as critical to the modeling of strategy distributed throughout the organization. Some activities are authorized specifically by the strategy and others that are authorized by the authority structure as being consistent with the aboutness of the firm and divisional identities in which the authority structure exists. This allows us to easily include one more addition to the formal model that deals with Mintzberg and Waters' (1985) dynamic strategy process that admits both planned and unplanned (emergent) strategies. We must make one more distinction about activities in the work group: their normative status. There are three traditional categories (deontic modes) for the normative status of an action:

a) obligatory (necessary),

b) permissible (optional), and

c) impermissible (forbidden).

For this model of strategy, we will use obligatory (as authorized in STRAT^T) to capture the planned strategic action and permissible to describe actions that are allowed as candidates for emergent acceptance. Note that the emergence in the sense we use it is not *naïve* emergence. We model it explicitly and, following Mintzberg and Waters, it's eventual inclusion into firm strategy is made explicit by the authority structure – the top management team. We use boldface **O** and **P** as the operators as follows.

During STRAT^{T} work group w_l^j has three activities, **O**{A_1,A_2} and **P**{A3}. We assume that **O**{A_1,A_2} are *obligatory* under STRAT^{T} and **P**{A3} is *permissible* under AUTH and *not impermissible* under STRAT^{T}.

Note that **O**{A_1,A_2} and **P**{A3} are *accepted* by all agents (members) of S, even if they are not visible to all agents outside work group w_l^j. To complete a temporal model of strategy evolution, we note one more normative state, **¬P,** as impermissible. Thus we have the following normative state transmissions between two strategic times, STRAT^{1} and STRAT^{2}.

STRAT^{1}		STRAT^{2}
O{A_1}	→	**O**{A_1} or **P**{A_1} or **¬P**{A_1}
P{A_3}	→	**P**{A_3} or **O**{A_3} or **¬P**{A_3}

Thus, a particular activity $\{A_1^1\}$ that is required by STRAT^{1} can become nonobligatory in two ways during STRAT^{2} -- permissible or impermissible. A nonobligatory but permissible activity **P**$\{A_1^3\}$ can remain in that normative status, become obligatory, or become impermissible in STRAT^{2}. This is an important action that occurs at the system level, S, whereby some members with agency in the authority structure, AUTH, at level S will authorize the update of the scaffold structure STRAT^{1} to STRAT^{2}. The consequences of the subsequent normative status will be evident by the allocation of work group w_l^j members (and other resources) to operational agency in the next strategic period. All members of w_l^j accept the normative status of the activities as part of Tuomela's (2013) social and normative circumstances -- our AUTH and STRAT, and tacitly through organizational identity. This acceptance drives the collective intentionality of the work group toward meeting group goals through their intentional action in **O**{A_1,A_2,..., A_m} and **P**{A_{m+1}, ..., A_p}. In S outside of w_l^j, there is acceptance that the activities of w_l^j conform to organizational-level AUTH and STRAT, without knowing what the activities are.

Inferences from the Formal Model for Unplanned Strategy and Dynamic Capabilities

We relate the formal model above to how the Mintzberg and Waters (1985) model of emergent and deliberate strategies can be given a microfoundation. From the section above on the scalability between micro-level constituent activities and the division- and firm-level, we see that permissible activities at the work group level may be codified as obligatory activities in subsequent strategy time. In modeling this phenomenon, one can depict the constituent new element of the strategy as (a) wholly within the work group where the activity has been undertaken, (b) as localized components in more than one work group in a single existing division, (c) as a new causal chain (of multiple work groups) in an existing division, or (d) as a new division. This will depend upon the authority structure AUTH of the firm and the authorization functions within $STRAT^T$. It will also depend upon the complexity of the causal chain necessary to complete the input-output relations for the new strategic element. There will also be path dependent processes that will interact with the authorization process. Consider that the component activities under (b), (c), and (d) may have developed in different strategy periods S^T. Moreover, the ability to identify the component activities and to co-locate them in a causal chain depends upon the constitutive relationships between $STRAT^T$ and the work-group and divisional strategies illustrated in Figure 6.

Assume three activities that are permissible under $STRAT^2$: $\{A_1\}$ in w_4^2, $\{A_2\}$ in w_4^2, and $\{A_3\}$ in w_5^2. $\{A_1\}$ and $\{A_2\}$ could be governed by the same work group-level constituent strategy but the knowledge of all three activities and subsequent authorization of their joint adoption as obligatory to a common causal chain in Division 2 would occur with the division-level constituent strategy. Thus, the division-level strategy is the relevant scaffold to support the recognition and subsequent development of this unplanned or emergent strategy.

If $\{A_2\}$ is a permissible activity in w_3^4, a work group in Division 4, then the necessary scaffolding must exist between Division 2 and Division 4 and not in either alone. That is, to recognize and authorize a

new strategic element between two divisions requires that there is some system-level authorization mechanism that has the necessary scope to operate as line (3) in panel A in Figure 6.

In sum, the strategy scaffold defined as $STRAT^2$ is not a monolith. If we desire a microfoundational account of planned and unplanned strategy, the strategy must have causal meaning as an impetus for work group collective action and a constitutive structure that permits *strategic scalability* within and between divisions. Strategic scalability is purposive and intentional and has the requisite authority to align work group-level activities and alter their deontic status.

The extension of the formal model to be a microfoundation for a dynamic capabilities account of strategy follows from the discussion above and a re-design of the Craver diagrams for depicting nested capabilities (mechanisms) in the system. If one chooses to define one or more causal mechanisms for strategy as dynamic capabilities, then the Craver diagram will not have constituent divisions as the highest level of constituent entities, but will have the capabilities in the middle panel of Figure 3. For the nested mechanisms within a given capability, separate activities may be identified as components[6] of a capability that can drive the dynamics of future planned strategies. (Teece 2007; Teece & Heaton 2015; Teece, Pisano, & Shuen 1997). As above, a strategic decision remains (between two strategy times S^t and S^{t+1}) as where the dynamic capability will be located in the system: (1) as a system-level causal chain that is causally connected to the divisions, (2) within a single division as a causal chain linked to work groups, or (3) distributed among some or all divisions. The sensing function (Teece 2007) must necessarily be located at the boundary of the closed firm to register causal information from the business environment (the red triangles in Figure 5). The strategic functions of seizing and transforming are also built upon the authority structure AUTH and some elements of the current strategy $STRAT^T$ that are committed to capability-building. Thus, they are scaffolds. In a model that is specific to the dynamic capabilities approach, the strategy scaffold may be split into a capabilities (or RBV or efficiency) element and a

[6] If it was clear in the literature that routines are constituent mechanisms within capabilities, rather than mechanisms at the same level of aggregation as the capabilities, the representation of their embeddedness in Figures 3 and 6 would be straightforward, as would their connections to $STRAT^T$.

dynamic capabilities element to make a distinction between the expected differences in the decision horizons. A consequence of making a model of dynamic capabilities is that the periodicity of strategy times will change -- more discernable strategy periods of shorter duration, so as to capture the necessary transformations and reconfigurations resulting from acting on environmental dynamism.

Recapitulation and Discussion

In this paper we argue that a microfoundational account of organization strategy must be more than summative of the actions of organization members. Moreover, any jointness of intention and action beyond small highly organized work groups which require that actors consciously acknowledge each group member's intentional states cannot be expected in a fully individualistic model because of bounded rationality and the limits to interpersonal communication in large groups. Finally, we argue that any microfoundational account cannot rely on emergence, which admits ignorance of the causal mechanisms and complex constituent relationships among individuals, teams, and business units.

To meet these desiderata, we accept the existence of we-intentionality within work groups of modest size that guides the agency of the work group. This model of behavior is drawn from social ontology and we leave aside a full-on individualistic model of distributed we-intentionality (Bratman 2014; Ludwig 2016) in favor of shared we-intentionality at the work group level (Tuomela 2013) as sufficient for a microfoundational account of strategy. Each work group w_l^j is a constituent member of a larger aggregate, division D^j. Work groups are linked as constituent elements of mechanisms embedded in the division and their activities form a causal chain in the value creation process. Those activities are authorized either explicitly by the strategy that is in place for the organization at that time, $STRAT^T$, or permitted by the authority structure, AUTH, that ties the constituent elements together in the firm. The authority structure, AUTH, and the strategy, $STRAT^T$, simultaneously bind the work groups (and by extension, their members) in the nested constituency relationships following the design of modern mechanistic explanation (Machamer, Darden, & Craver 2000; Craver & Povich 2018) and locate the

work groups within the causal chain (agency) that aggregates to the system level, S. The design of the mechanistic explanation for complex systems is superior to the Coleman bathtub as it is specific about locating entities and activities temporally and spatially within the organization.

Someone might argue that a microfoundational account of strategy that explicitly includes the strategy as a component would be a circular argument. We contend that the essence of a formal organization is that there is a formal structure and a *raison d'être* that is by design more than summative of the intentionality and actions of individuals. Strategy and the authority structure buttress the "we-ness" and "about-ness" that may be incompletely governed by the organizational identity. But the more interesting virtue of the strategy in a microfoundational account is as the distributed causal impetus for actions by individuals. In our model, it links the "about-ness" of the organization explicitly to the we-intentionality of work groups in a manner that governs the deontic status of those actions.

The explicit incorporation of the organizational strategy into a microfoundational account of individuals' actions also permits two important functions in a dynamic model of the firm and its constituent components. First, the strategy in place for any period, $STRAT^{T}$, solves the limitations to large group action from bounded rationality. As an external cognitive artifact, the strategy directs work group we-intentionality and collective action distributed through the constituent mechanisms of the system. Second, the strategy becomes an object upon which the system-level authority structure (i.e. the top management team) acts to update system level activities by authorizing new strategic activities from emergent permissible actions in embedded mechanisms and de-authorizing current activities in a future instantiation of the strategy $STRAT^{T+1}$. Thus, the dynamics at the work group level and at the system (firm) level are equally explicit, though certainly more visible at the system scaffolding level - at the organizational level that has been the locus of strategic management for the past three-quarters of a century. We would characterize this model as a hybrid process-content account of organizational strategy, as it is explicit in how the current strategy governs some, but not all, micro-level actions and it is explicit in how agency at all three levels of analysis alters the governing strategy between on strategy period and the next.

The model described above in both the graphico-verbal presentation and in the formal presentation serve as a foundation for extensions and modifications that can serve the specific needs of future research. In its present form, the model serves as a basis for a longitudinal microfoundational case study by specifying the requirements for capturing both constituent relations between the work group level and the strategic apex of the firm and the important (horizontal) causal chains (for strategically important activities to the case study). Then the authority structure and its actions (i.e. authorization) for both planned and emergent strategy will form the dynamic framework that mimics Figure 5 above. Similarly, the model as it exists can serve as a template for designing a system dynamics model to simulate in an idealized form the multiple levels of action.

The present model can be altered to be fully individualistic by allocating intentionality to individual work group members. It will require additional scalability mechanisms to make the work groups operational, as required by the model as $\mathbf{O}\{A_1\}$ above. Note that if the mechanisms to do this automatically create fully operational teams or they are presumed to be emergent, then there is no explanatory gain from forced methodological individualism. But the more reductive model may permit more explicit treatment of recruiting new organization members and accounting for defections from membership.

The model may easily include other scaffolding devices or more highly developed mechanisms for developing and distributing corporate culture or other collective intentionality states through the firm/system. The top management team may be made explicit as a particular ontological group with its actions formally modeled as inputs to system- and division-level causal chains. This amounts to adding mechanisms for activities of authorization that are tacit under AUTH as we have described it.

We regard our modeling effort as a response to the challenges posed by Barney and Felin (2013) and Felin, Foss, and Ployhart (2015) to model rather than invoke microfoundations. We also hope this effort will be seen by scholars in organization theory and strategy as an invitation to improve and extend reductive models in future scientific discourse.

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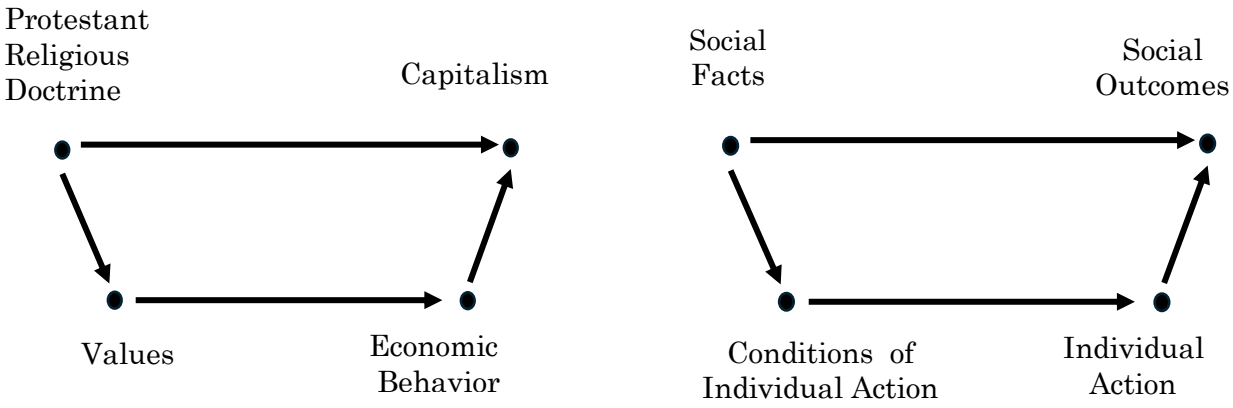
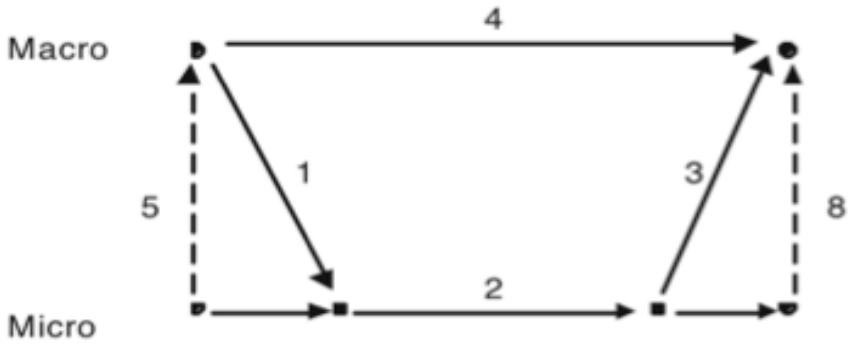
Figure 1. Macro-micro linkages (Coleman's bathtub)



Source: Coleman 1990

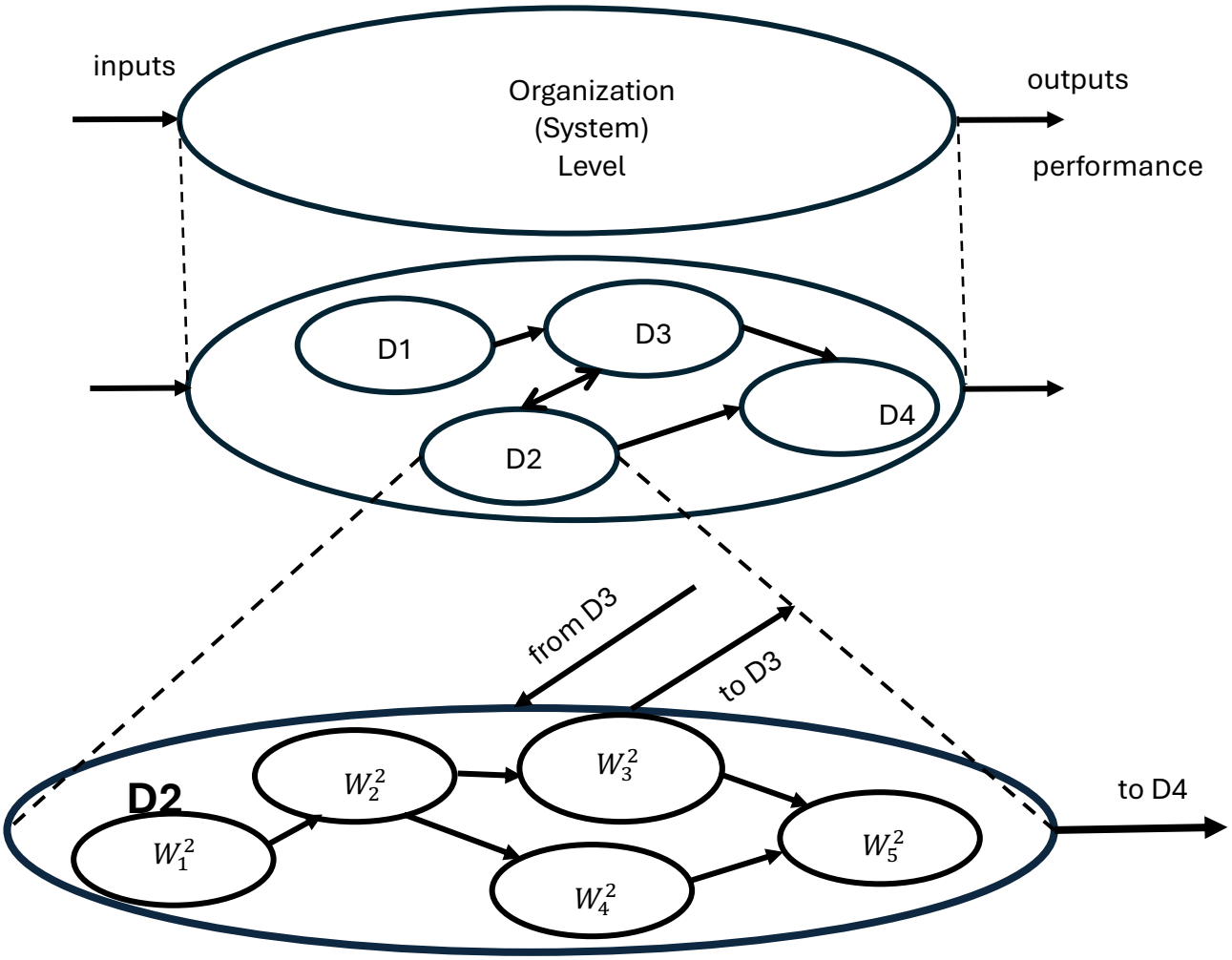
Source: Abell, Felin,& Foss 2008

Figure 2. Squaring Coleman's diagram



Source: Vromen 2010

Figure 3. Graphical Representation of Nested Mechanisms in the Organization



Work Groups W_1^2 W_2^2 W_3^2 W_4^2 W_5^2 in Division D2

Figure 4. Organizational Development Stages and Causal Relationships -- Internal and External

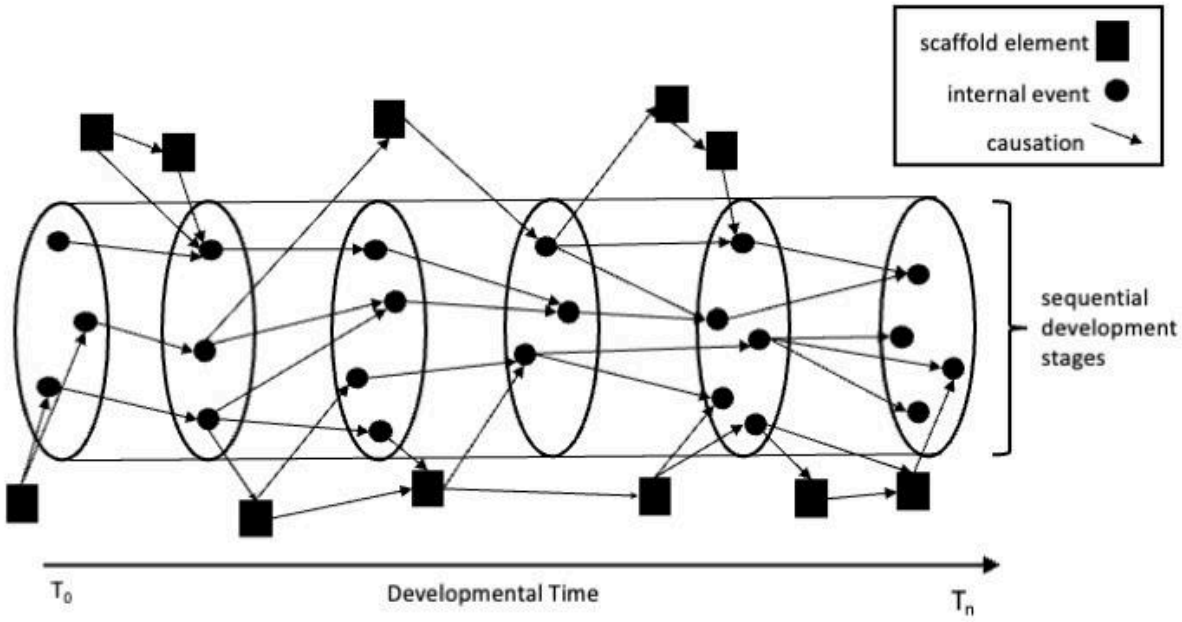


Figure 5. Representation of the Organization (System) Structure
and Strategy (Scaffolding) Through Time

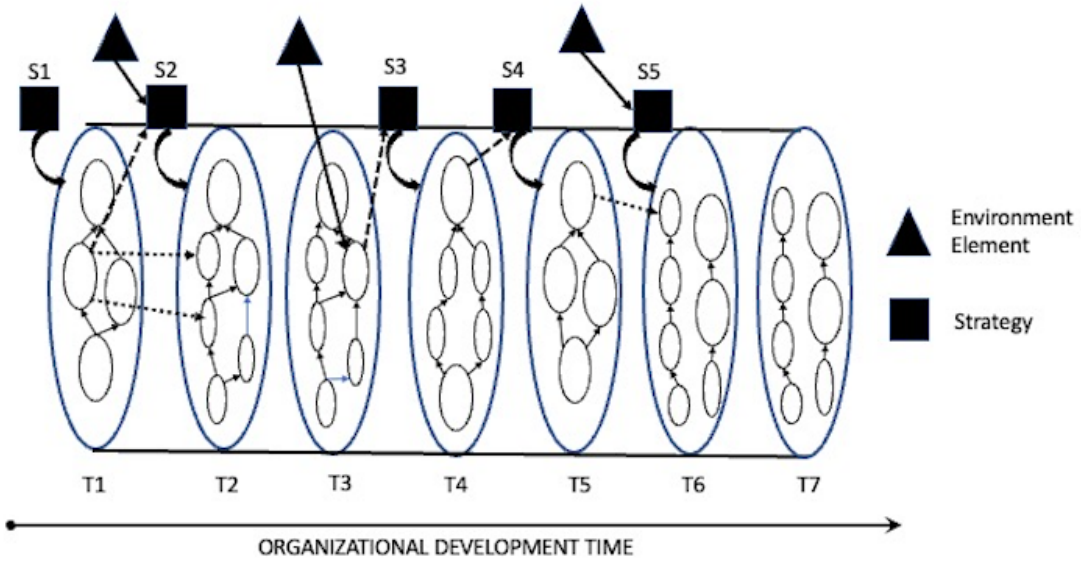
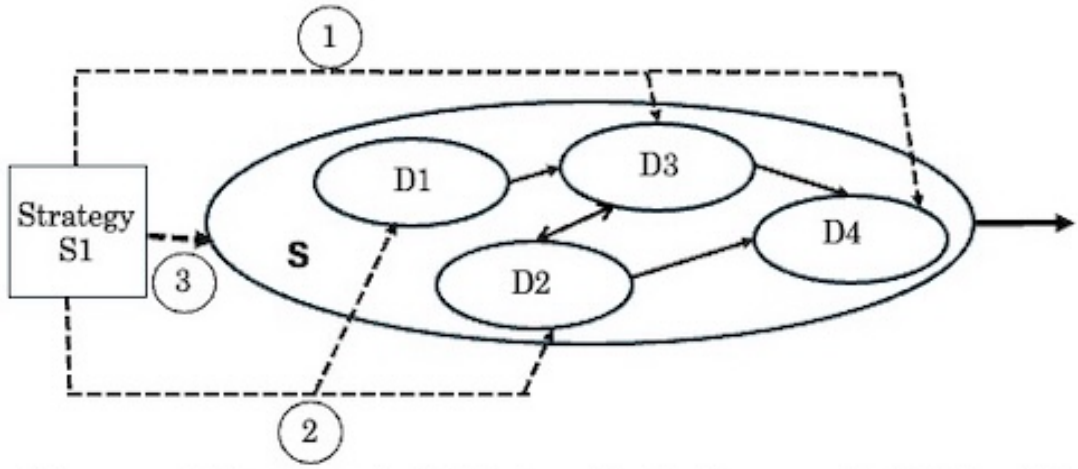


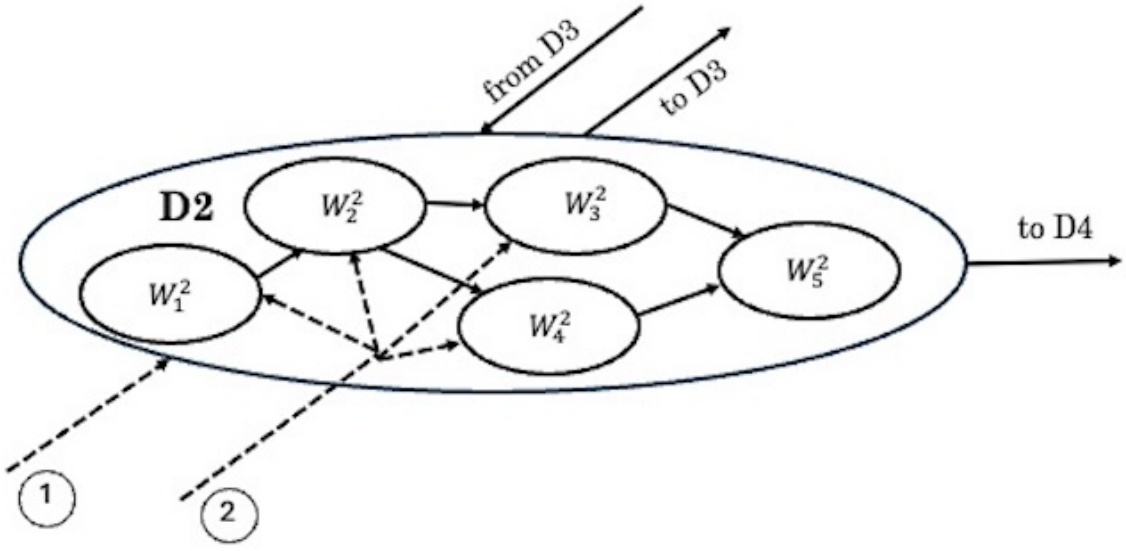
Figure 6. Connecting the Strategy Scaffold to Micro Entities

Panel A



Line (1) represents elements of strategy S1 that are *localized as causal* to Divisions D3 and D4.
Line (2) represents elements of strategy S1 that are *localized as causal* to Divisions D1 and D2.
Line (3) represents system-level elements of strategy S1 that cannot be localized as specific to any of the constituent divisions.

Panel B



Line (1) represents elements of strategy S1 localized to D2 but not further localized to any specific constituent work groups W^2_j
Line (2) represents elements of S1 localized to work groups W^2_j within D2