A Functional Taxonomy of the Occupational Structure

Jorge Rodríguez Menés

E-mails:

jorge.rodriguez@upf.edu

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Department of Political & Social Sciences
Universitat Pompeu Fabra
Ramon Trias Fargas, 25-27
08005 Barcelona
http://sociodemo.upf.edu/
Abstract

This paper proposes to conceptualize the division of labor functionally, as a response to environmental variations and instabilities that lead to alternative forms of horizontal – task – and vertical – role – differentiation. Relying on contingency theory, the paper describes the main sources and manifestations of these two forms of functional differentiation, and the alternative modes of integrating tasks and roles within structures that are more centralized, hierarchical, and formal as the environment becomes more heterogeneous and unstable. The result of this exercise is a rich taxonomy of the division of labor with multiple and clear criteria intended for classifying occupations according to their technical characteristics.

Keywords

Taxonomy, Division of Labor, Occupational Structure, Contingency Theory

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Introduction

Analyzing the technical Division of Labor (DoL) is crucial for understanding inequalities, as DoL’s positions are the object of strategies of appropriation and exploitation that lead to unequal rewards and life chances. Yet, while many stratification studies consider DoL’s technical features (if only because they make use of occupational information), only the sociology of work measures and conceptualizes them explicitly. A problem with this approach is that it tends to be descriptive and rely on micro-observations of people’s skills at work – work’s substantive content (Cain & Treiman, 1978; Kohn & Schooler, 1983; Fine & Cronshaw, 1999; Felstead et al., 2007) – while it omits the analysis of jobs’ functions and their sources – work’s organizational aspects. The latter is the realm of the sociology of organizations. However, because the latter focuses on other units of analysis, its findings have not been systematically applied to the sociology of work (Gallie, 1991; Simpson, 1985). There are analyses on the professions that take an “open system” or ecological perspective (Abbott, 1988) but they rarely extend to other tasks.

This paper seeks to fill this gap by applying multiple perspectives to build a technical taxonomy of the largest organizational form – the DoL –, one that could serve as a guide for classifying occupations. The classification itself is not the object of the paper, as it requires a careful operationalization and validation that exceed its scope. Instead the paper aims to establish the taxonomic principles on which occupational classifications should be based. These principles are borrowed from the sociology of organizations, based on concepts that are not always clearly defined in the literature nor linked to each other explicitly because they were never intended to serve a taxonomic purpose. This paper first contribution is thus to the sociology of organizations, offering an analytical synthesis of different approaches that, under the umbrella of contingency theory, share a similar view of organizations as functional responses to environmental uncertainties (Katz & Kahn, 1966: 3; Thompson, 2003: 7; Stinchcombe, 1983: 33-34). The second contribution is to the sociology of work. The paper applies contingency theory’s ecological approach to understanding occupational differentiations, treating occupations as sets of activities seeking to adapt to distinct demands posed by a varying and changing environment. The paper describes the main sources of heterogeneity and uncertainty affecting the DoL and elaborates on how it adapts to them: first, by categorizing diversity into homogenous segments and dedicating specialized activity sets to process each – i.e., by horizontal or task differentiation (Woodward, 1980: 97) –; and second, by isolating vulnerabilities to ecological hazards and dedicating decision-making roles to manage them (Simon, 1997: 108) – i.e., by vertical or role differentiation (Woodward, 1980: 97). A third form of adaptation, less formalized but still much discussed in the literature, is also considered – the decoupling of DoL’s core tasks from boundary-spanning roles (Thompson, 2003; Child, 2005: 81).

The paper is organized as follows. The next two sections discuss the horizontal and vertical axes of occupational differentiation. The following section introduces the oblique form of differentiation separating non-operational roles from operational tasks. The final section defends the functional approach to classifying occupations espoused in this article.
Functional Responses to Environment’s Diversity

Contingency theory argues that human activities are organized to adapt to environmental variations (Hannan & Freeman, 1989: 93). Spatial diversity or temporal instability is the source of these variations. The contrast between operational and non-operational tasks made in contingency theory reflects this difference in sources of variations (March & Simon, 1993: 17; Simon, 1997: 39). Non-operational decisions are non-consensual, reflecting the uncertainty of temporal variations. They are treated in the next section. Operational responses enjoy a consensus on their effectiveness since are based on well-known spatial variations (March & Simon, 1993: 17). They are treated in this section. Figure 1 aims to summarize and facilitate the arguments that will be made in it.
Contingency theory argues that operational activities result from differentiating tasks according to environment’s heterogeneity (Lawrence & Lorsch, 1967: 157). Four sources of heterogeneity are frequently discussed. Two pertain to the properties of environment’s elements, and two, to their inter-relations. Environments’ elements differ, first, in their attributes. Each complete set of complementary attributes defines an area (field, niche, variable). Second, elements differ in how their attributes are combined in unique ways to pose distinct or clientelistic ecological demands (Stinchcombe, 1990: 66). As for elements’ inter-relations, they can be isomorphic or non-isomorphic (Hannan & Freeman, 1989: 93). Isomorphic relations ensue between elements sharing the same attributes. Their numbers define the density of a field (Hannan & Freeman, 1989: 131; Morris 1987; Peterson et al 1998: 15). Non-isomorphic relations occur between elements with different attributes that nevertheless respond to the same exogenous stimulus. Their numbers define environment’s distinctiveness. Functional specialization responds to these sources of heterogeneity by differentiating tasks by purpose or by process (Simon 1997: 38-39). Differentiation by purpose produces tasks that seek to fulfill the needs of different areas or of different clients. Differentiation by process takes advantage of elements’ interrelations to magnify the scale or scope of the response (Carlile et al., 1989; Levin 2000; Subramaniam & Watson, 2006: 919), i.e., how many elements are affected by it within or across fields. In sum, environment’s composition (the attributes and the combinations of attributes characterizing their elements), and the density and distinctiveness of element’s inter-relations lead to functional specializations by area, client, scale, and scope.

Two different veins in the sociology of organizations elaborate on such forms of functional differentiation. They focus either on dependencies or on interdependencies arising between functionally differentiated tasks (Thompson, 2003; Powell & DiMaggio, 1991; Wageman, 1995; Van der Vegt & Van de Vliert 2001). In fact, dependencies and interdependencies are two sides of the same coin. First, task differentiation requires factoring out the conditions that activate tasks (March & Simon, 1993: 213), thus generating task dependencies. Second, these conditions create different interdependencies that constrain how tasks must be performed (McCann & Ferry, 1979: 113).

The conditions for task activation may require pursuing the same end with multiple means (Wageman, 1995: 145) or applying the same means to achieving multiple goals (Thomas, 1957; March & Simon, 1993: 213). Consequently, the literature distinguishes between outcome and mean dependencies. Outcome dependencies result when tasks’ inputs cannot be shared and must be assigned to distinct tasks, as with physical inputs (Crowston, 2003: 98). The literature identifies two types of outcome dependencies – goal and reward. While it does not elaborate on their sources, it is clear that they must stem from, respectively, area and client differentiation. When tasks are specialized by area, their activation depends on other tasks fulfilling the needs of others areas, all contributing to the goal of sustaining a common environment (Yu, 1997). In contrast, when tasks react to specific ecological demands, tasks’ goals must be additionally aligned to achieve a unique reward or result (Simon, 1997: 81). As for means dependencies – also called role or duty dependencies (Thomas 1957; Mohr 1971; Wageman 1995) – they are typically divided into resource and positional dependencies. Both require frequent human interactions (Pfeffer & Salancik 2003: 41; Johnson & Johnson 1989). Resource dependencies result when tasks share an input (Malone, 2004: 141) – e.g., a bit of information (Crowston, 2003: 97). Sharing allows the synchronous use of resources within the limits placed by operations’ scale. Positional dependencies result from scope.
differentiation. In this type, several tasks are equally responsive to the needs of another tasks pursing its own goals (Pennings, 1975: 827; Johnson & Johnson 1989; Simon 1997: 81).

Distinct forms of task interdependence ensue from each form of dependency. Goal dependencies impose conformability conditions on tasks’ outcomes – they must fit together to achieve common goals (Malone, 2004: 141). They generate pooled interdependencies, whereby outcomes are forced to conform to standards (Thompson, 2003: 54). Reward dependencies additionally impose a flow or order among outcomes (Malone, 2004: 140; Wageman, 1999: 201), creating sequential interdependencies between tasks (Thompson, 2003: 54-55). Resource dependencies produce concurrent interdependencies or one-to-one synchronous correspondences among activities sharing the same inputs (e.g., following a conductor’s lead) (Malone & Crowston, 1994: 95). Finally, positional dependencies (Pennings, 1975) generate reciprocal interdependencies that require non-recursive, iterative adjustments to meet a range of possible goals. Reciprocal and concurrent interdependencies are common in team work (Van de Ven et al., 1977: 325).

Each form of interdependence is best handled by a coordination technique: standardization, in order to pool independent efforts; serial specification, for arranging sequences; synchronization, for handling concurrent operations; and mutual adjustments, for responding to reciprocal demands (Thompson, 2003: 56; March & Simon, 1993: 182; Stinchcombe, 1990: 37; Sanchez & Mahoney, 1996: 66).

The distinction between dependencies, interdependencies, and coordination opens the way – unexplored in the literature – to establish a division of labor. One set of tasks, which occupants are here labeled setters, specializes in fixing the conditions – outcome or mean dependencies – for other tasks’ activation. Another group of dependent tasks either coordinates interdependencies or executes the tasks i.e., either switches among standards, serial arrangements or synchronous and mutual adjustments, or fulfills the activities. These two specialist groups are here labeled switchers and doers, respectively.

However, the most important form of task differentiation is horizontal, based on the parallel lines of dependencies, interdependencies, and coordination techniques stemming from different environmental sources. Next, it is argued that relations among staff specialists originating from horizontal differentiation are looser or tighter depending on how easily can tasks be decomposed (March & Simon, 1993: 216-217); that task decomposability depends on whether tasks are differentiated by purpose or by process; and that this leads to the grouping of tasks in departments with less or more centralized organizational structures.

In highly decomposable environments where elements can be decomposed into areas or clients, factorization can be applied repeatedly and responses can specialize in tasks that always perform the same few activities (Thompson, 2003: 59). The DoL is here arranged in what the literature calls federal structures of tasks linked by goal or reward dependencies and affected by pooled or sequential interdependencies (March & Simon, 1993: 216). The simplest tasks are found in these decentralized structures. They are single-outcome tasks pursuing particular or interconnected goals in alternative chains. In contrast, in hardly decomposable environments, process differentiation prevails to benefit from elements’ inter-relations. Tasks consist here of composite structures of activities (March & Simon, 1993:
that cannot be separated because they are affected by reciprocal or concurrent interdependencies. These tasks – especially the latter – are the most complex. They must make multiple adjustments and activate many other activities (Lawrence & Lorsch, 1967: 94). They perform more distinct activities and take longer to complete.

The mutual and synchronous adjustments characterizing composite structures of activities require assigning them to single tasks (or to tightly knit teams of tasks). However, whether tasks are fully dedicated to making adjustments or must additionally perform the activities needed to achieve a given purpose depends on operations’ scale and scope. When both are low and few adjustments are needed, reciprocal and concurrent interdependencies are coordinated within federally arranged tasks (March & Simon, 1993: 42). When scale or scope is high, tasks are coordinated within composite units that determine how – when, where – other tasks must operate. These last, dependent tasks must be additionally differentiated by purpose and pursue other independent goals, or else they would remain idle until activated by the processing core, thus being more likely to be absorbed by it, undermining specialization by process. Only when scale and scope are at an intermediate level and processes are applied to tasks dedicated to other purposes, savings in coordination costs can be made by dedicating more subsets of activities to process constraints on how these other tasks are performed (Thompson, 2003: 57-58). Differentiation by process is here highest because more tasks are dedicated to regulate and constrain other tasks’ operations (March & Simon, 1993: 43).

A well-known principle of the sociology of organizations is that in these mixed structures of composite and independent tasks relations between processing and peripheral tasks must be organized in a “matrix” form (Galbraith, 1973: 103). This form imposes a centralized structure of process and outcome dependencies which allows the core to perform synchronic or mutual adjustments while the periphery performs simpler tasks for many purposes. The most complex tasks are found in these mixed structures, which are also the most heterogeneous, as they contain tasks coordinating all interdependencies. In contrast, in simpler and federal structures, tasks coordinate mostly pooled and sequential interdependencies. This explains contingency theory’s claim that interdependencies form a Guttman-type scale (Thompson, 2003: 56). All structures require standardizing tasks’ outcomes. Fewer additionally require tasks to be arranged in sequences. Still fewer must further synchronize tasks operations. And only the most complex additionally contain sets of mutually adjusting tasks. These mixed and centralized structures, typical of large organizations like the DoL, are the most differentiated horizontally. Horizontal differentiation leads here to maximum departmentalization – task clustering within different organizational units according to tasks’ typical dependencies and interdependencies.

Four departments are regularly cited in the literature: production, distribution, administration, and research and development (Simon, 1997: 29-31; March & Simon, 1993: 41; Woodward, 1980: 97; Chandler, 1962: 12). Each seeks to provide an adequate response to environmental variations in, respectively, elements’ independent and combined attributes and in the density and distinctiveness of their relations. In each department tasks result from applying, respectively, area, client, scale, and scope criteria of differentiation. Thus, they have developed different relations among activities based, respectively, on sharing similar goal, reward, resource, and positional dependencies. Dependencies condition how activities must interact with each other, i.e., their interdependencies – pooled, sequential, concurrent and reciprocal – and the techniques coordinating them – standardization, serial arrangements,
synchronization, and mutual adjustments, respectively. Multiple dependencies and interdependencies are found in more centralized structures. The most central tasks are in R&D departments. They generate and interactively apply new methods for mixing tasks located in other departments. Tasks in administrative departments require fewer mutual adjustments and much synchronizing of shared resources (Mentzas, 1993). Office orders’ indeterminate arrival may require adjustments, but of a unidirectional kind that can be met by switching between parallel sequences of actions (Hewitt, 1986). In distribution departments, clients’ specifications in the form of, say, seasonal variations in demand are best met via supply chains tailored to customers’ orders. Commonalities may cut across distinct markets, and orders be aggregated into parallel product lines, but clients’ specifications prevent adjusting to them synchronically or ad-hoc (Stinchcombe, 1990: 128). In production departments, coordination by standardization is typical (Thompson, 2003:16).

**Functional Responses to Environment’s Instability**

While environments are differently heterogeneous, they also change over time, posing hazards to its functioning and exposing tasks’ vulnerabilities (Wisner et al., 2003: 11; Cutter, 1996). This section presents the main responses for tackling such vulnerabilities. Figure 2 aims to facilitate its reading by summarizing its main arguments.
Typically, hazards are distinguished by their degree of predictability and the damage they can inflict. Predictability is often associated with the fine or coarse grained patterns in which hazards manifest. Damage is defined in terms of the time needed for a system to recover from a hazardous impact and function properly. Both criteria can be combined to create a typology of vulnerabilities with four types ordered by hazards’ seriousness. The least serious stem from hazards with fine-grained frequency distributions and of ephemeral consequences. Hazards of short-term consequences manifesting in large and irregular “patches” create more serious vulnerabilities because they occur without warning (Hannan & Freeman, 1983: 106). More predictable hazards with long-term effects generate still more serious vulnerabilities. They ensue from many random events, each having little impact on the environment, but all jointly capable of affecting it in the long-term (Hannan & Freeman, 1983: 106). The most critical vulnerabilities stem from hazards difficult to predict and of enduring consequences (Simon, 1997:76; Abbott, 1998: 49).

Vulnerabilities require functional answers which, through role differentiation, stabilize environment’s fluctuations. Roles or element functions (Woodward, 1965: 17, 97) deal with procedural, not substantive, criteria of action, regulating how to make good decisions for managing hazards (Simon, 1997: 106-107). Decisions, in turn, are choices about courses of action with uncertain outcomes (Simon, 1997:4; Mintzberg et al., 1976: 246; Locke et al., 1990; Thompson & McEwen, 1958). This makes roles’ activities non-operational – it cannot be determined beforehand if the goal is worth pursuing or attainable efficiently (March & Simon, 1993: 177), only afterwards if the result satisfied a need at an assumable cost.

Contingency theory argues that alternative decision-making techniques are best suited to handle each type of vulnerability (March & Simon, 1993: 169, 191; Thompson, 2003: 19-23, 67; Scott, 2003: 199-202). This paper proposes to distinguish the techniques by the intentions and commitments formulated in the decision (Simon, 1997: 31; Chandler, 1990:11; Mintzberg, 1978; Cohen & Levesque, 1990) and link each to a distinct type of hazard. Intentions can be tactical or strategic (Child, 2005: 113; March & Simon, 1993: 177), depending on the short or long-term consequences they seek to avert. Commitments can be irrevocable or revocable, depending on hazards’ higher or lower predictability. By combining the two distinctions, four types of decision-making often discussed in the literature can be identified, respectively more capable of tackling more serious hazards – prioritizing, preventing, projecting, and planning.

When hazards are predictable and have ephemeral consequences, it is advisable to prioritize or irrevocably commit to lines of action that worked well in the past in similar circumstances (Simon, 2001: 122; Scott, 2003: 200). If wrong, the consequences are assumable. In contrast, vulnerabilities to coarse-grained hazards of short-term effects require preventative tactics which, like provisioning, buffer their negative impact. This is achieved by committing more resources than those strictly needed for stable conditions. When hazards are long-span and fine-grained, they allow projecting, based on forecasts, long-lasting and irrevocable courses of action with the lowest risks of failure (Scott, 2003: 201) but high potential sunk costs (Simon, 1997: 76; Cox, 1983). Finally, planning consists of strategic formulizations of long-term, revocable decisions that help adjust to unpredictable and critical hazards (Margolis, 1960; Stinchcombe, 1990: 123; March & Simon, 1993: 201; Simon, 1997: 109; Cox, 1998) and which, as in sequential decision-making, often appear as “post-hoc patterns in streams of decisions” (Mintzberg, 1978: 935).
If coordination techniques help handle task interdependencies, governing modes of control help formulate decisions. They signal the initiation or the continuation of a course of action (Child, 2005: 112), leading in ergonomics to distinguishing feed-forward from feed-back modes of control (Schreyogg & Steinmann, 1987; Preble, 1992; Hollnagel, 2006).

Feed-forward modes of control authorize decision’s operational viability, assessing if it is doable. Stinchcombe (2001: 45-53) identified four main authorizations – prescriptions, agreements, guarantees, and validations. Each is adequate for authorizing different types of decisions. Tactical decisions about predictable hazards of minor consequences are authorized by identifying – prescribing – the operational treatment with the highest record of success. Tactical interventions aimed at mitigating unpredictable hazards of ephemeral consequences are authorized via agreements reached after extensive deliberations or bargaining resulting in pledges to provide what is needed to attain the goal. Strategies for which a probability of success can be estimated are activated through guarantees – formal assumptions of limited (often collective) responsibility after assessing operational failure’s risks. Finally, long-term plans for unpredictable hazards of critical consequences require issuing formal validations certifying the operational viability of the tasks that might be called forth by the plan.

Feedback control aims to enforce decisions, amending deviations from non-operational goals when they occur. These can ensue from wrong decisions made by lower-order roles in embedded hierarchies or from operational problems that cannot be solved with coordination. The literature distinguishes four feed-back control modes. It is argued here that they result from crisscrossing two criteria of differentiation pertaining to outcomes’ commensurability and undoability. An outcome is commensurable if it directly fulfills a non-operational end and incommensurable if it contributes to it by meeting one in a hierarchy of goals. Commensurable outcomes accompany more often tactical decisions, for their short-term effects facilitate the assessment of their adequacy. Incommensurable outcomes thrive in strategic courses of action, as deviations may occur at many points in a chain of decisions (Stinchcombe, 1990: 249). As for whether outcomes can or cannot be undone, the literature distinguishes compensatory from anticipatory corrections (Abbott, 1988: 48). The former are appropriate for unpredictable deviations requiring revocable commitments; the latter, for predictable deviations which corrections can be anticipated after a given threshold is reached.

The combination of these two differentiation criteria gives rise to four modes of feed-back control: monitoring, tracking, regulating, and targeting (Hollnagel, 2002: 12). Monitoring compares tasks’ outputs against standards through inspection (Ouchi, 1979: 935). It is appropriate when deviations’ range is assessable and can be offset with compensatory actions. When results are assessable against standards but corrections must be anticipatory because affect other decisions – as when inserted in a sequence – feedback control coalesces into tracking – a continuous assessment of current status relative to end goals via supervision. If outcomes are incommensurable or poorly observable because highly contextual or affected by many contingencies, but they can be placed within a normal range by some other criterion which helps guide their adjustment, control is best achieved by regulating them – by assessing and enforcing outcomes’ compliance with rules (Ouchi, 1979: 835). When outputs and performances are incommensurable and corrections cannot be undone, feedback control coalesces into targeting, a loose assessment of the present situation relative to the end goals.
Insofar as authorizations certify decision’s operational viability, they are best issued by task experts. In contrast, decisions’ formulations and enforcements are best handled by role officers. This is the basis, unexplored in the literature, for setting up a division of labor between authoritative experts and the two groups of officers who, respectively, make and enforce decisions, here labeled entrepreneurs and controllers.

Yet, role differentiation is mainly vertical – the result of factoring out responses to differently serious hazards and assigning hierarchically ordered roles to handle each (Aldrich, 1999: 127; Simon, 1997: 186; March & Simon, 1993: 212-213). Responses to frequent, short-lived hazards are factorized first and assigned to lower-order roles. Highest-order roles emerge last to manage critical hazards. In fully differentiated, vertical structures a hierarchy of roles ensues whereby decisions aimed at prioritizing and buffering activities from short-term hazards become subordinated to long-term projects and plans. This subordination mirrors the subsumption of less serious hazards under more serious ones, a logical result of their temporal span and the preeminence of coarse-over fine-grained hazards.

Vulnerabilities are indeed cumulative. All decision-making structures are exposed to short-term disruptions requiring remedial action, but fewer must also buffer fluctuations in inputs/outputs. Still fewer additionally need prospecting the future to prepare for hazards unleashed after long periods of build-up, and just a few further require planning ahead against critical contingencies. As environments become more unstable, role distinctions become more pronounced and role structures, more hierarchical. Vertical differentiation fuels hierarchization, ensuring that lower-order decisions are aligned with higher-order ones (Simon 1997: 308), and deviations detected and amended via feed-back control.

Hierarchization is often measured continuously, by counting organization’s number of supervisory levels (Spaeth, 1979: 751; Oldham & Hackman, 1981: 71), but this is less feasible in hierarchical environments regulated, for example, by contracts (Stinchcombe, 1983). Other ordinal constructs can better capture hierarchization in these cases. They are here systematized along two contrasts. One, derived from hierarchy theory in ecological studies, distinguishes non-nested from nested hierarchical structures (Allen & Starr, 1982; Salthe, 1985; Wu, 1999). In nested structures, lower-order roles’ decisions are contained within higher-order ones’, contributing to align tactical decisions with strategic ones. In non-nested hierarchies, higher-order roles’ decisions constrain but do not contain lower-order ones’ (e.g., a dominant position in a market). The second contrast is less systematized but appears recurrently in the sociology of organizations under different labels. It distinguishes dedicated from idiosyncratic structures according to decisions’ irrevocability or revocability – a result of hazards’ higher or lower predictability. By combining both contrasts, four hierarchical structures often analyzed in the literature are identifiable – competitive and cooperative networks, pyramids, and adhocracies.

Competitive networks are, like markets, non-nested and dedicated, populated by many decision-makers constraining each other’s actions by setting up their own priorities. Whilst individual roles face high death rates due to cyclical changes in environmental conditions (Hannan & Freeman, 1989: 88), the structure itself is stable. Niche differentiation prevents hazards from spreading across fields and stretching into the distant future, limiting decisions’ impact and holders’ responsibilities. While limited responsibilities make competitive
networks less hierarchical, roles can still be ranked by the influence of their decisions on other roles’ priorities (Levine & HilleRisLambers, 2009; Allesina & Levine, 2011).

When contingencies have ephemeral effects but are idiosyncratic (Kranton & Minehart, 2000) roles are organized in cooperative networks. Powell (1990) placed them between markets and pyramids. In ecological studies, they are called mutualistic networks (Bascompte & Jordano, 2007) because agents must cooperate directly to sustain the structure (Jones et al., 1997). Hazards’ unpredictability calls for revocable commitments that help amend deviations in distribution chains when they occur. This makes decisions appear as if improvised or fit to agents’ skills (Moorman & Miner, 1998: 698; Miner, 1987: 328). Hierarchy arises here between generalists who diversify their risks by cooperating with many agents and specialists that cooperate only with a few (Bascompte & Jordano, 2007).

Pyramids have subordinate roles nested within super-ordinate ones, and short-term decisions aligned with long-term ones. Subordination does not mean determination, or lower-order roles could not process projects and plans’ “informal” details (Stinchcombe, 2001: 185; Simon, 1997: 197). Rather, roles higher up the hierarchy stabilize the conditions under which lower roles make decisions, ensuring that they are aligned with protocols and regulations.

Finally, in adhocracies (Mintzberg & McHugh, 1985) lower order roles’ subordination must be flexible enough to respond to hazards affecting plans’ implementation. Adhocracies combine dedicated structures’ inertias with revocable commitments capable of managing idiosyncratic shocks, as in incident command systems (Bigley & Roberts 2001). Backward control is exerted loosely, by setting targets. Adhocracies combine all four types of decision-making and have the longest hierarchies (Stinchcombe 1982: 115). Full officialization occurs in these structures. Top officers make the most consequential decisions (Stinchcombe 1990: 7) and have the highest responsibilities (Simon 1997: 187).

In Chandler’s (1962: 12) account of American firms’ genesis he described how four managerial offices – field, departmental, central, and general – developed over time with their peculiar administrative duties, needs, and modes of control. Each ensued from pursuing alternative growth tactics and strategies that were differently adapted to tackle hazards of shorter or longer-term consequences and of higher or lower predictability (Chandler, 1962: 13). Hence, each can be seen as heading one of the four managerial structures discussed above – competitive and cooperative networks, pyramids, and adhocracies.

Decoupling and Formalization

Diversity and uncertainty are ecology’s two basic dimensions. They spark alternative functional responses (Thompson, 2003: 7). Integration refers to the structures of lateral and vertical relations of dependence and subordination accompanying task and role differentiation (Lawrence & Lorsch, 1967: 11; Child, 2005: 80; Galbraith, 1973: 93; Miller, 1987: 57; Scott, 2003: 239) and – it is argued next – to the oblique links between offices and departments emerging from decoupling non-operational roles from operational tasks.
The first two forms of integration have already been discussed. Centralization accompanies processes of horizontal differentiation where tasks cluster within departments linked by relations of dependence. In contrast, hierarchization results from processes of vertical differentiation where roles cluster within offices linked by relations of subordination. The two forms of differentiation shown before separately in Figures 1 and 2 can be seen as defining a map of the technical DoL. Figure 3 presents this map and serves as a summary of the arguments that will be made in this section.

The two axes of Figure 3 define the quadrants where the main structures of offices and departments have often been located in the literature (Burns & Stalker, 1961: 120-121; Donaldson, 2001: 25; Child, 2005: 97; Aldrich, 2007: 82). However, there are two problems with conceptualizing the DoL in quadrants. First, the combinations of high hierarchization and decentralization and of centralization and low hierarchization are dysfunctional. Centralization is most useful when hazards are critical and need unified operational responses; decentralization, when roles are un-nested and uncertainties cannot spread across tasks (Stinchcombe, 1990). Seeing it differently, while operational tasks apply the best known solution to a problem, they are still exposed to hazards from errors and exceptions that increase with tasks’ scope (Perrow, 1967; Dosi & Egidì, 1991). Similarly, while role’s decisions are sub-optimal by definition, they require mastering coordination techniques to
assess if operational problems imperil goal attainment. Centralization and hierarchization are positively associated due to hazards’ propensity to rise in diverse environments, pushing functional responses toward an imaginary diagonal line running from the bottom left to the top right corners of Figure 3. Drawing on Katz & Kahn’s work (1966: 144) four genotypic structural combinations of departments and offices can be located along this line: generative, supportive, reproductive, and innovative (the classification differs slightly from Katz and Kahn’s to accommodate the departmental and office distinctions made before). The four structures link, respectively, producers to field officers; distributors to departmental officers; administrators to central officers; and researchers to general officers. They are increasingly complex – more hierarchical and centralized – and composed of more departments and offices linked through horizontal and vertical relations of dependence and subordination.

The second problem with DoL’s conceptualization in quadrants is that it overlooks the need to insulate structure’s technical core from environmental hazards by decoupling central from boundary-spanning activities, thus stabilizing tasks’ operational conditions (Thompson, 2003: 20; Perrow, 1986: 148; Stinchcombe, 1990: 220; Miller, 1987; Aldrich, 1999: 77). Decoupling separates operational from non-operational functions, fostering occupational divisions between line officers and expert staff. It must run deeper in hierarchical and centralized structures because hazards spread there more easily, pushing tasks and roles farther away from DoL’s diagonal, and separating more deeply staff and line in more diverse and unstable environments. Left to its own dynamics, decoupling would place all staff on a horizontal line at the bottom of DoL’s map, and all officers on a vertical line on its far left. All expert work would be routine; all managerial work, standard. This is precluded by the positive association between diversity and instability attracting staff and officers to the diagonal. The interplay of the two forces pushing functions farther and closer to the diagonal with different strengths gives the DoL a funnel-like shape.

As decoupling proceeds, different forms of integrating roles and tasks within all four genotypic structures arise. This paper proposes to conceptualize this as a process of division of authority between officers and staff formalized differently in each structure (Simon, 1997: 197). While formalization is often measured continuously, by how much authorizations are issued legally (Weber, 1978: 217), or job duties spelled out in writing (Hage & Aiken, 1967: 79; Pugh et al 1968: 75), it is more appropriate to conceptualize it ordinally, as expressing kinds, not just degrees, of formality (Stinchcombe, 2001: 184). It manifests differently depending on decoupling aims, leading to two forms of integrating roles and tasks. They are here labeled operational and non-operational integration to stress staff and officers’ importance in each. Which one prevails ultimately depends on whether uncertainties affect the application of old methods to new problems or of new methods to old problems.

Decoupling first aim is to prevent non-operational uncertainties from spreading into operational tasks, avoiding over-commitment to goals when unachievable (Cohen & Levesque, 1990). It does this by formally granting feed-forward control – operational authority – to experts over the technical implications of decision-makers’ choices (Stinchcombe, 1990: 90), making the latter dependent on the former’s authorization. Operational integration affects three functions: non-operational decision-making (entrepreneurs’ function), operational goal-setting (setters’ function) and operational execution (doers’ function). Setters integrate entrepreneurs’ decisions and doers’ functions by translating non-operational into operational goals. Since setters’ work is to find known
solutions to new problems they are best suited to certify decisions’ operational viability. Setters’ authorizations are expressed in the words of the feed-forward mechanism of control used to assist entrepreneurs in formulating decisions in each structure: as plan validations, project endorsements, provision agreements, or priority prescriptions. The heavier is setters’ goal-setting workload, the less centralized are their tasks – the fewer interdependencies they must coordinate – and the more hierarchical are their roles, pushing them up and left in Figure 3 along an imaginary, oblique line connecting staff to officers in each structure. The translation of non-operational into operational goals increases setters’ chances of making knowledge-based mistakes (Rasmussen, 1987; Reason, 1990), i.e., cognitive errors in finding solutions to problems. Formalization is more effective in reducing these errors than in managing the multiple exceptions and rule-based mistakes in implementation that characterize tasks requiring extensive coordination (Perrow, 1967; Reason, 1990). Thus, operational integration is common when setters’ instructions can be implemented by doers, who are exposed only to minor slips in performance (Rasmussen, 1987). When these slips can be easily predicted or contained below a threshold, doers’ tasks can be mechanized or computerized (Autor et al., 2003; Murnane & Levy, 2004).

Decoupling second aim is to prevent operational uncertainties from spilling over non-operational roles, precluding the wane of staff’s commitment toward non-operational goals when exceptions or rule-based mistakes in execution question decisions’ viability (Cohen & Levesque, 1990). It does it by formally assigning backward control – non-operational authority – to controllers (Simon, 1997: 191) who integrate tasks and roles by subordinating staff to officers. Non-operational integration affects two functions in all structures: feedback control over non-operational goals (controllers’ role) and coordination of tasks’ interdependencies (switchers’ task). Controllers judge if operational innovations or deviations imperil non-operational goals’ attainment, constituting a “violation” of the decided course of action (Reason, 1990), and if tasks must be amended. This requires mastering coordination techniques, pushing controllers closer to staff and helping them express their authority in staff’s words, as monitoring of standards, tracking of throughput, regulations of synchronous tasks, or targeting of iterative processes. Non-operational integration is more common when tasks need extensive coordination/switching and the probability of rule-based mistakes in execution is high. Controllers’ must determine if these errors question original decision’s viability or are mere slips that can be solved by switchers.

Figure 3 displays operational and non-operational forms of integration as lines of different patterns linking the major functional groups of entrepreneurs, controllers, setters, switchers, and doers within each genotypic structure. While, as noted in the introduction, paper’s aim is not of to classify specific occupations within DoL’s major functional groups, Figure 3 provides some examples, giving some concreteness to the discussion.

In sum, this section drew on contingency theory to describe three processes of task and role integration often mentioned in the literature but rarely systematized or connected – centralization, hierarchization, and formalization. Centralized and hierarchical integration were seen as manifesting in relations of dependence and subordination accompanying vertical and horizontal processes of task and role differentiation. The literature’s tendency to portray these processes as orthogonal and produce structures of lowly and highly centralized and hierarchical functions was disputed. Instead, it was argued that both processes are strongly associated due to hazards’ tendency to increase in more varied environments. Were it not for
the decoupling of tasks from roles preventing non-operational and operational hazards from spilling over, respectively, tasks and roles, centralization and hierarchization would be equivalent. It was argued that decoupling must run deeper in centralized and hierarchical structures because of hazard’s critical nature, giving the DoL a funnel-like shape. Deeper decoupling requires more formal mechanisms of integration or controls apportioning authority to roles and tasks. Two controls were identified. Feed-forward control was seen as being typical of operational forms of integration that make decision-makers dependent on expert staff’s assessment of decisions’ operational viability. These experts are the very same setters who, in finding old solutions to new problems, set up operational goals for simpler tasks requiring little coordination. In contrast, feed-back control was seen as characterizing non-operational forms of integration where controllers assess if exceptions or errors in switchers’ coordination question non-operational goals’ attainment. To exert it correctly, controllers must master the coordination techniques of the staff they supervise and assess problems reported by other controllers down the line.

Discussion

This paper has relied on contingency theory to analytically dissect the largest form of human organization – the Division of Labor – and elaborate a taxonomy of its main functions. The DoL was conceived as sets of tasks and roles adapting to environment’s diversity and instability. The approach is hardly original, as it builds on concepts broadly discussed in the literature. Yet, these are often given equivocal meanings or analyzed without much reference to each other. In contrast, here they were defined precisely and unified into a single theory. This has practical, theoretical, and methodological advantages.

The sharper definitions offered in this paper provide clearer practical guidelines to classify occupations. Multiple classificatory principles and denser analytical links between concepts facilitate categorizing occupations even if, as it is common, some measurements are missing. For example, we might lack data on the interdependencies handled in a job but still succeed at classifying it by observing how they are coordinated or by identifying which tasks it depends upon for activation.

The taxonomy has also theoretical advantages, improving our knowledge of the DoL. It grounds horizontal, vertical and oblique forms of occupational differentiation on distinct technical responses to ecological demands. This is not today’s prevailing view, which emphasizes contractual relations and incentive systems over job’s technical functions (Garicano 2000). While the contrast between horizontal and vertical differentiation is well established (Kalleberg, 2000 & 2009) – as when the hierarchical post-war regime of bureaucratic production is compared to flatter and flexible forms of work organization – the
tendency is to portray the two organizational forms as orthogonal, and to interpret recent changes as a paradigmatic shift towards less hierarchy (e.g., renewed competition, demise of internal labor markets, rise of occupational markets) (Hollister 2004). Yet, there are as many hierarchical elements in today’s adhocracies as there were lateral dependencies in the Fordist work organization. Identifying the sources and manifestations of vertical and horizontal differentiation can improve our understanding of today’s new forms of work organization.

Starting with vertical differentiation, the paper argued that markets are low in the hierarchy of non-operational roles unfolding to handle increasingly critical hazards. Today’s organizational forms have not signalled a return to (now global) markets, which never vanished. Rather, markets have become embedded within cooperative networks, which in turn have been embedded within bureaucratic pyramids, which in turn have been embedded within adhocracies. The new organizational forms are more, not less hierarchical, than former ones. Drawing attention to role embeddedness in decision-making hierarchies is one of paper’s contributions. It allows perceiving today’s most complex structures of decision-making as ad-hoc mixtures of bureaucracies and markets implementing long-term plans to respond to unpredictable hazards of enduring consequences.

As for horizontal differentiation, it was here defined as a process of both task specialization and structuration along relations of dependency, which reaches its highest level of centralization in wide-scope, composite structures processing multiple operational tasks in heterogeneous ecologies. Like hierarchization, centralization was depicted as a cumulative process – centralized structures of complex tasks develop only after decentralized structures of simpler tasks function autonomously for other purposes. The rise of flexible specialization in R&D departments typifies this process. A core of mutually adjusting professionals applying wide-scope methods to many purposes (Piore & Sabel, 1984; Autor et al., 2003) guides dependent staff’s work in peripheral sub-structures of decentralized, contingent jobs (Goos & Manning, 2003; Kalleberg, 2003). Some claim that flexible specialization ensues from skill-biased technical change – the selective impact of automation on tasks requiring different skills. According to this view, machines replace tasks requiring routine manual and cognitive skills because these follow clear rules, while complement tasks requiring non-routine cognitive skills. They have no effect on client-interactive jobs affected by context (Autor et al., 2003; Murnane & Levy, 2004). The theory here espoused identified similar tasks as being at risk of automation, but for reasons pertaining to risk’s sources – the higher predictability of the operational hazards which tasks are exposed to – rather than tasks’ skill content. The theory does not require analyzing skills to classify tasks. The classic analyses describing DoL’s positions with multiple measures of workers’ cognitive and non-cognitive abilities are problematic, for skills are individuals’, not positions’, attributes. Mismatches between positions’ requirements and workers’ skills are frequent (Ortiz 2010). The two should not be used interchangeably. A common solution is to measure jobs’ required skills. However, this does not fix skills analysis’ second problem – its focusing on the content rather than the organization of work activities. In skills analysis tasks are defined by their manual or non-manual content or how much they require working with things, people, or data, or, simply, by unspoken criteria of complexity, as with the unskilled, semi-skilled or skilled distinction. The justification is that these features correlate highly with self-direction or the spatial, verbal, or cognitive abilities exerted in a job (Kalleberg & Griffin, 1980; Spender, 1983; Kohn & Schooler, 1983; Parcel & Mueller, 1989; Oldham & Gordon 1999). Since these qualities are observed, they must serve a purpose, but this is rarely spelled out. Skills analysis tends to omit skills’ functions and sources and suffers from an excessive empiricism.
The alternative here espoused is to conceive tasks as adaptive mechanisms responding to environments’ properties and relations between elements. These mechanisms exist in all ecologies and define DoL’s most basic functions. Once they are identified, it should be easier to classify occupations across functional groups in different societies and times.

The paper also enhances our understanding of what were here defined as oblique forms of differentiation that decouple tasks from roles. Decoupling – it was argued – prevents the spreading of operational uncertainties along non-operational roles and of non-operational uncertainties across operational tasks. It leads to assigning feed-back and feed-forward mechanisms of control over activities to, respectively, decision-makers (controllers) and staff (setters). This approach offers a more balanced view on how organizations integrate tasks and roles than one that focuses primarily on the integrative role of feedback control. It questions recent claims about the current pervasive transfer of authority from decision-makers to specialists, confining it to situations where entrepreneurs depend on setters’ expertise to find efficient responses to new needs (Hales, 2005). The literature on flexible forms of work organization supports this interpretation. It stresses the advisory or service role (feed-forward control) played to firms by professionals, paralleled in industrial districts by autonomous providers and craft contractors’ (Piore & Sabel, 1984; Kalleberg, 2000). The literature shows how these groups are helped by dependent workers, as contemplated here for non-operational integration. In contrast, operational integration requires staff to be subordinated to decision-makers, so as to establish which need or problem can a current practice meet or solve. It was here argued that this role emerges when staff’s work is subject to many errors and exceptions, i.e., when operational uncertainties encourage non-compliance with non-operational goals. It is played by first line supervisors and managers, not by entrepreneurs (Hales, 2005). This approach allows identifying which staff are most likely to experience feed-back control – switchers coordinating extensive interdependencies – and which decision-makers are most likely to exert it – controllers who, like senior specialists, combine specialized knowledge of coordination techniques with general competencies guiding their application (Garicano, 2000). Economists portray relations between both groups as conflicting, and controllers’ role as aimed at minimizing switchers’ opportunistic extraction of composite rents when there is high asset-specificity (economists’ word for interdependence) (Williamson, 1985; Sørensen, 2000; Goldthorpe, 2000). However, neither is opportunism the only source of operational hazards nor is controllers’ main technical role to meter effort. Opportunism is one among several possible causes preventing tasks from exerting their functions efficiently. Operational hazards vary depending on tasks interdependencies, giving rise to different feedback controls. Economists focus too narrowly on simpler controls aimed at monitoring standards or tracking tasks along chains, ignoring more complex forms, like regulating or targeting. This is due to their interest in metering individual effort for efficiency reasons, easier if interdependencies result from outcome instead of means dependencies and when tasks are arranged in federal instead of composite structures. Yet, from a technical point of view metering effort is relevant only if its intensity must be regulated or jeopardizes goal attainment. Controllers’ technical role is to assess if deviations from operational goals serve new purposes or must be amended to attain the intended non-operational goal. In short, feedback and feed-forward controllers play different integrative roles. Which prevails might depend on economic and institutional factors intentionally omitted in this paper to strengthen its methodological underpinnings.

Taxonomy’s final advantage is indeed methodological. Its focus on DoL’s technical aspects avoids the problems of more eclectic methods that mix socioeconomic and technical factors to rank occupations along status scales, or cluster them into classes facing similar life chances.
or structuring events (Duncan, 1961; Goldthorpe et al., 1980; Ganzeboom, et al 1992; Wright, 1997; Rose et al., 2010). This eclecticism prevents detecting each principle’s contribution to stratification and properly accounting for the prominent part played by technical factors for adapting to diverse and unstable conditions. Socioeconomic accounts minimize this relevance arguing that whether work is divided into tasks and roles and assigned to different people depends on whether it pays to do it – a function of how often tasks and roles are performed (Williamson, 1985) – or serves some interests – a function of people’s power (Marglin, 1974; Powell & DiMaggio, 1990). Yet, to satisfy either motive, work must first be decomposable into functions. Socioeconomic factors can account for functions’ distributions and consequences, but not for their nature. Functions are the mechanisms through which socioeconomic factors exert their stratifying effect, but are determined exogenously by environmental demands, and thus can and should be measured independently. The measurement here proposed consists of an ordering of functions based on clearly defined relations of dependency, subordination, and formalization.

In sum, the taxonomy offers practical, theoretical, and methodological advantages that enhance our understanding of the technical DoL and other complex organizational forms.
References


