Chapter 1

We the Engineers and Them the Managers

1.1. Introduction

People have managed since the beginning of time. When men were hunter gatherers, women managed families. The development of agriculture involved developing new management skills and techniques [MIT 99]. The Mandarins who administered imperial China were professional managers, and had training in mathematics, sciences and engineering [NEE 86]. Engineer-managers were crucial to the success of the Roman Empire, building roads that connected it and aqueducts that enabled urbanization [CHA 08, HOD 01]. In the Middle Ages, masons were both engineers and managers with their own highly effective and multinational professional association [BLO 68], and guilds that insisted on training and professional recognition for membership [DUR 57] were also central to the emergence of civic institutions [BRA 82]. Brunelleschi was an engineer-manager, inventing new engineering techniques and directly supervising the construction of the dome for the *Duomo* in Florence [COO 90]. Napoleon established the *Grandes Écoles* for engineer-managers that still flourish in modern France. From the early to mid 19th Century, Isambard Kingdom Brunel, who built the first iron ship, bridges, docks and railways, was a mechanical and civil engineer who directly managed their construction [VAU 91].

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With a transition from entrepreneurial to modern capitalism [BER 32, BUR 62], this changed. At a technical level, engineers became increasingly important. Yet when engineering breakthroughs such as in electricity and telephony emerged, and were applied by those such as Edison and Bell, there was a change. With economies of scale such as Ford achieved with serial mass production, and as giant corporations rapidly came to dominate markets, professional management was needed [LAC 87]. When Will Durant took over what remained of the US auto mobile industry in General Motors, banks and shareholders insisted on bringing in Sloan, an accountant rather than an engineer to manage, which developed into 3M (Minnesota, Mining, and Manufacturing Company Limited) multidivisional management structure, which then became paradigmatic for big business [SLO 64, WOM 05, WOM 96].

But in the process a divorce emerged. Veblen [VEB 21] in his *The Engineers and the Price System* wrote that "businessmen are increasingly out of touch with that manner of thinking and those elements of knowledge that go to make up the logic and the relevant facts of mechanical technology…". He allowed that industrial experts, engineers, chemists, mineralogists and technicians of all kinds have been drifting into more responsible positions in the industrial system and have been growing up and multiplying within the system, because it will no longer work at all without them [VEB 21, p. 26], but they rarely became professional managers. Veblen also castigated emerging neoclassical theories of the firm for their presumption that managers simply combined capital and labor and that anything else, such as technical progress was simply a residual. In contrast, like Schumpeter [SCH 49], he claimed that it was engineers who created new products, processes and, with them, enabled new markets, while Schumpeter himself contrasted creative innovators from managers, as administrators. Corporate strategy became important [CHA 62], yet led to inflexible mind sets [SEN 90] and then declined in effectiveness [MIN 94] such as that there was nothing to be learned from post-Fordist models of flexible production and "lean" engineering developed in Japan [WOM 05, WOM 96] which is now common in Asia.

This relates to innovation trajectories and product cycles. For decades, in western management theory, it was assumed that a product is first innovated, then grows and then matures [VER 66]. Yet, according to Schumpeter [SCH 49] this may spawn other products that may transform the initial innovation, such as mobile phones initially displacing fixed line telephones, then incorporating cameras and keyboards and enabling access to texts without the need to go to a library. Such transformations were achieved by

engineers and it is engineers who can advance this unless they are blocked by managers who may have no training or experience in engineering [OLI 13].

Perceptions of roles and identities also are influenced by either explicit or implicit logics [OLI 07a, OLI 06, OLI 00, OLI 12]. A profession such as engineering has distinctive features similar to medieval guilds [DUR 57] including a formal code of ethics, criteria for certification as member of a recognized professional association and the monopoly of a specific labor market by regulating the entry of members. By contrast, management does not have these features. Even if there are explicit commitments to ethical and other codes in corporate mission statements, these may prove to be rhetorical [LOK 10]. Tacit rules and implicit norms in organizations [OLI 07a], whether as in Enron, World.com or the more recently revealed Libor interest rate manipulation, may override the explicit commitment to ethical codes in mission statements. Engineering and management also have different criteria and sanctions for performance. If an engineer designs a bridge that collapses, then his or her professional reputation is destroyed. If bankers design financial derivatives that collapse the western world, they can continue to pay themselves bonuses unrelated to performance, which may change public perceptions of banks, and incur public protest, but without necessarily affecting their careers.

Barley [BAR 06] has cited a range of studies distinguishing between basic and applied researchers. These indicate that the latter are usually engineers who are more concerned with recognition within organisations and a managerial career, unlike scientists and management theorists for whom recognition depends on publishing research findings. Yet these, and perceptions of them, may be asymmetric. An engineer working as manager is likely to be accepted with or without a professional qualification in management whereas this is not the case with a manager presuming to be an engineer.

This chapter indicates that engineers nonetheless may be reclaiming the roles and professional identities of earlier engineer-managers. It analyzes this in terms of theories of personal and professional identity, subject–object relations in terms of theories of “the self and the other” [SCH 18, SAR 57, HOL 13], the role of self-direction and other direction [RIE 54] and factors influencing both initial career choice and later career moves in relation to concepts of boundaryless or Protean careers. In doing so, the chapter extends Schneider’s [SCH 83, SCH 87, SCH 90] attraction–selection–attrition (ASA) theory or ASA model from personnel selection and candidate choice to career choice and draws on but qualifies Foucault’s [FOU, 72, FOU 77] concept of

power-knowledge. Using case study evidence, it illustrates the mediating effect of the perceived comparative status (PCS) of engineers toward managers in the relationship between professional identification and professional commitment.

In asking whether managers are a professional reference group for engineers and, if so, whether that influences career choices, the chapter addresses the following exploratory propositions (EP):

EP1: engineers perceive cultural differences along with an unbalanced status between engineers and managers;

EP2: Foucault's theory of power-knowledge can be qualified in terms of managers having power but engineers having knowledge;

EP3: Schneider's ASA theory is relevant to engineers initially being attracted to engineering as a profession but then wishing to avoid narrow job-fit by qualifying as managers;

EP4: it has implications for differing perspectives on boundaryless or Protean careers.

1.2. Identities and values: the self and the other

The relationship between engineers and management has been studied in terms of different roles and identities, as well as different organizational cultures ranging in Human Resources Management (HRM) terms from "soft" in terms of cooperation and group working in Japan and other Asian cultures to "hard" in some more individualistic market cultures such as those of the United States [BOW 10, LEE 92, LEE 06, LEE 10, SHA 98, SHA 03]. This varies in whether or not there is a high degree of trades unionism, including professional associations [STU 08], even if some professions prefer not to conceptualize their associations in such terms, as well as with different degrees of commitment of higher level management to human resource management policies such as retraining and requalification [CAB 04].

Identities also involve different perceptions and cognitions that are influenced not only in terms of a Cartesian *cogito ergo sum* [DES 37] but also in terms of who we have become through the acquisition at varying levels of consciousness of values, beliefs and dispositions derived from both life and professional experience [HOL 13]. Such cognitive and social processes are not only functional but also existential in terms of relations between "the self and the other" in the sense of existentialist philosophy and

literature from Schopenhauer to Sartre [SCH 18, SAR 57, HOL 13], where the self and individual perceptions are subjective and include choice and scope for self-direction whereas the other is objective, as in an organization or a profession.

This self–other distinction is paralleled in the cognitive-experiential self-theory of Epstein [EPS 90, EPS 91, EPS 92, EPS 93, EPS 94] that premises that "…everyone develops an implicit theory of reality that contains subdivisions of a self-theory, a world theory, and propositions connecting the two" [EPS 90, p. 165]. This relates also to whether people are disposed to be self-directed or other-directed that Riesman [RIE 50, RIE 54] developed in relation to whether they are disposed to be "one of a crowd" or to stand out, or strike out on their own.

Cognitive psychologists have wavered between the view of the individual as a competent and rational being and a view with limitations for rationality and its biases [SCO 01]. Identity is influenced by mental pattern and schemata in a categorization system with group influences, expectations and even stereotypes [TUR 87, BAR 95, HOW 00, SEN 90]. Burke [BUR 04] explains the relation between the individual and the social structures with the identity control theory. Identity theories also recognize differences between passivity and non-passivity of the individual in relation to contextual factors, social systems and roles [BUR 04], which parallels Riesman's [RIE 50, RIE 54] concepts of self-direction or other-direction. Careers relate to institutional logics, mechanisms of corporate governance and division of labor [JON 07]. However, this is not always in a manner that may be self-enhancing or career enhancing, as in how Adam Smith himself recognized that division of labor may "numb the mind" [SMI 76, ROT 00] and the degree to which this may incentivize engineers to escape this by seeking to qualify as managers rather than be constrained as "mere" technicians.

Careers therefore involve both subjective and objective factors. The subjective concerns perceptions, senses and feelings by individuals about their own career and their future while the objective includes perceptions by others [ARN 08, NIC 05]. This ontological duality is recognized, notably by the Chicago School, where the objective dimension is associated with forms of professional identity in society and the subjective dimension is represented in the meanings that individuals attach to their career, while these may change over time [BAR 89]. A career can be planned in advance, such as choosing in the first instance to study engineering and becoming an engineer, yet then retrospectively reconsidered [YOU 92, YOU 04] also in terms of seeking greater personal fulfillment through a career change.

Both subjective and objective factors profoundly influence careers and career choice [ARN 08]. Some of the variables are also more tangible than others [VAN 77a] while some are social in terms of shared perceptions of what is a good career or a good career choice [ART 05]. Nicholson and de Waal-Andrews [NIC 05] have suggested six recurrent career indicators including: (1) hierarchy and status, (2) material success, (3) social reputation, prestige and influence, (4) knowledge and skills, (5) personal relationships, contacts and friendships and (6) health and well-being.

Identity is formed and sustained by social interaction. It allows us to see ourselves as similar to a class of individuals with whom we associate ourselves or want to be associated [GIO 98, TAJ 86, MAT 88]. Self-categorization is integral to social identity [ASH 89]. People tend to assume identities in relation to others in prototypical terms such as belonging to a particular organization, gender identities and religion [ASH 89]. It plays two roles: both cognitive at varying levels of consciousness and as an ordering of the social environment. Howard [HOW 00] stresses both individual cognition and social interaction in the development of the self. Burke [BUR 04] relates this to validation and verification, assuming that once an identity is adopted it must be continuously controlled for its social validation, while internalization of acceptable behavior and symbols is part of its self-verification.

Identity, self-direction and career development may be resource constrained, ranging from whether an individual has the resources to invest in a further qualification, such as an MBA or MSc, to whether a general economic environment is constrained by lack of market demand and there are pressures on governments to reduce public spending and investments, as since the onset of the Eurozone crisis in which one of the first investments to be cut or postponed may be major engineering projects [VAR 12]. Yet, Tajfel and Turner have put forward a theory of social identity independent of resource constraints [TAJ 79, TAJ 86]. This recognizes the importance of groups in individual identity such as the difference between in-group and out-group identities that are not necessarily economic or material. The reasons given for this are (1) the need for positive self-esteem, (2) self-perceptions within particular groups (social identity), (3) a positive social identity that can be achieved or enhanced by comparison with relevant out-groups and (4) differentiation in terms of identification *foci*.

The salience of social identity is a dynamic variable depending very much on organizational and operational context [DIC 05]. For example, the knowledge and skills important for professional practice are necessary but not sufficient conditions for professional preferment. As with Riesman's

[RIE 50, RIE 54] concept of self-direction, it favors those who have both a strong personal and professional identity [COS 05, p. 29], yet also implies that they should not be so self-directed as not to disregard the tacit rules and implicit norms of a group [OLI 07a], especially at operating levels such as in a legal or design practice or an engineering group. Professional labeling has been claimed to be a mechanism for control in the sense that it constructs the job identities and appropriate behaviors [FOU 99]. The meaning of being professional is therefore an important discursive construction [CLA 09], but not only so. Professional identity is sensed and felt rather than necessarily being explicit [MAT 88].

1.3. Symmetries, asymmetries and career dynamics

Perceptions by individuals, groups or professions may be either symmetrical or asymmetric. For example, an engineer working as a manager is commonly accepted. The presumption that a manager can take engineering decisions is not accepted. Symmetries and asymmetries also relate to both individual and group identities and to both sets and subsets of meanings at varying levels of consciousness [MAT 88]. This is an ongoing process of symmetrizing who we are and what we are expected to be, or what we perceive that others want us to be [MAT 88]. It is integral to the principle of semantic congruence [BUR 81] and thus gaining consistency [HAV 94].

Such processes are dynamic [DUB 96]. The interaction concerns space for the self and for social interactions with others [MAC 03], yet may not be linear rather than dialectical, such as finding that there is asymmetry rather than symmetrical "fit" between what we aspire to be and what is expected of us by others and then seeking a career move. Or that a young engineering graduate may initially be fulfilled in gaining a "good job" and glad to be able to sustain it, whether or not a partner is working, yet in midlife sense that they are "ceilinged in" by a narrow job-fit, which may mean that they seek to qualify as managers and achieve higher levels of self-realization in terms of Maslow's hierarchy of needs [MAS 43].

Engineers who start their careers as such may come to want more than simply working as one, and seek a career shift into management, even if the prospects for this remain uncertain [BAK 96, ROU 98]. Whether they do so by Hirschman's "voice" internally with an organization, or by needing to "exit" [HIR 70] will be influenced by not only by their own sense of self, but also by how they are perceived by others at higher levels of management [BAK 96, MIR 94, KIN 05].

John Arnold [ARN 01] stresses that careers imply subjective and objective interactions, potentials and constraints. A career is a sequence of positions, roles, activities and experiences encountered by an individual, whether employed or self-employed. Career progression is not limited to upward mobility within an organization. Horizontal mobility may be as important if it means job variation, while stepping back or down, as in opting to work part time, is also a career move, which is also supported by others [ART 96, ART 05, OLI 07b]. Lee [LEE 92] analyzes dynamics in the relations between management and engineering that vary between different cultures, often with overlapping roles.

Cultural context should not be displaced, yet nor should it be exaggerated. For example, the engineering breakthroughs that were achieved by Toyota after WW1 in achieving *kaizen* style continuous improvement were not dependent on a Confucian culture but on a very western style industrial dispute [WOM 96] as well as by the *kanban* principle of automatic restocking and delivery of components on a just-in-time rather than just-in-case principle that had been developed earlier by American retailers yet never taken up by US manufacturers [COL 00a].

In addition, line with shifting dynamics in individual or group perceptions, some objective indicators of success such as pay and position may gradually lose their significance in terms of Maslow's hierarchy of needs, and higher levels of self-fulfillment become more important [MAS 43]. Thus, what are considered career needs may change over time [ART 99, ART 05]. When a social identity is unfulfilling, psychologically or economically, either in terms of job-fit, group-fit or organization-fit, the relationship is asymmetric and an individual may exit with the aim of joining or forming others with more symmetrical values and goals. Yet career change need not imply "exit" rather than "voice" [HIR 70]. For managers whose skills are in market demand, "voice" may enable recognition, with or without formal negotiation, and promotion with associated pay and other benefits [ART 05].

Professionals can find stability in an ambiguous environment using anchors of identity such as being expert or being different [BEE 08]. Representations (physical, symbolic, verbal, textual and behavioral) become imbued with meaning and are taken as part of the identity [BEE 08]. Identity has multiple dimensions of which three are: (1) the values, dispositions and beliefs that individuals implicitly acquire not only from professional but also life experience [OLI 07a, OLI 13]; (2) tacit rules and implicit norms in behavior, which may both underlie and override formal job descriptions or

organizational mission statements [OLI 07a, OLI 13] and (3) discourse in identity production and reproduction [BEE 08].

In acquiring and defining social and professional identity, individuals may consciously seek professional qualifications and also accept the norms that are embodied in work roles [DUT 94, ELS 01, HUM 02]. This may symmetrize self-esteem with the identity of the organization including its external image and depend on whether an individual is identified as "fitting" within a presumed identity profile [ASH 90, ASH 89, DUT 94, HIN 89, HUM 02] or as "one of us" in the famed term of Margaret Thatcher, which could imply that they either are included and may gain one or more rungs on a promotion ladder, or excluded as permanent "outsiders".

Professionalization is therefore a dynamic process through dyadic pass or fail for entry to the profession, followed by explicitly defining criteria for work methods [DIM 83] through tacit rules and implicit norms acquired at varying levels of consciousness from work experience [OLI 07a]. This requires symmetrization [MAT 88] including "fitting in" rather than only the knowledge, abilities and skills for job-fit [OLI 07a]. Yet the need to symmetrize with the image of an organization may also provoke dissent rather than assent, with ridicule of prescribed roles in camaraderie and humor, counter-narratives, irony and cynicism [CLA 09]. Within some organizations individuals and groups may have considerable freedom in creating their reality, shaped by the social discourses available [HUM 02]. Identity is an interactive process equivalent to the writing of one's history, seeing how it be written by others and identifying ourselves in the discourses of others [SIM 05a, SIM 05b]. On the other hand, it may be a process of absorption within a larger narrative [BEE 08].

1.4. Evolving identities and professional reference groups

Identity formation by reference to others is central to self-development from childhood in terms of parental or other role models, peer groups in adolescence and to professional groups. Some reference groups are stable, durable and long lasting [KRO 76]. Others may change either slowly, or quickly, such as in the case of perception of breach of psychological contract [ROU 95, ROU 98]. Relationships also tend to imply power [KRO 76] and power-knowledge may be implicit at any level of an organization [FOU 72, FOU 77]. A professional group that holds hierarchical power does not need to change its values or terms of reference [KRO 76]. Also, although self-identity is largely formed by late adolescence or early adulthood, it may

be changed by less than conscious referential processes in operational contexts and by language specific to a profession or work group [INK 07].

Thus, group and professional identities are not static but interact dynamically [TAJ 79]. The knowledge and narratives shared by group members influence choices and actions and less consciously defined boundaries. Lipiansky distinguishes between belonging to a group, linkages between groups and reference groups influencing behavioral values and norms [LIP 90]. Identities are therefore internal to an individual as "self" yet also relate the individual to "the other" [SCH 18, SAR 57] and interface with different social situations, contexts and relationships, and change over time [BUR 98].

Professional identity construction may start in families, as with children of doctors becoming doctors, but will also be influenced by secondary and higher education choices [DUB 97]. Later socialization and training in work contexts have a key role [MIG 09]. Professional identity is based on a sense of belonging to a professional group recognizable by society [PER 07]. Socialization at work is the product of power relations and collective standards for behavior, with a representation of identity as a backdrop. Professional identity is linked to the adoption of norms and values of a particular profession. The strength of an identity can be related to the commitment to the profession and to the understanding that the organization represents a space for the advocated professional identity. As Luckmann and Berger [BER 73] emphasize, the development of a professional identity is assumed as a dimension of secondary socialization, applied in the specific field of an activity with specific symbols. In addition, identity is constructed from expected roles [BAU 98].

As supported by the findings of Burke and Franzoi [BUR 98], identities are dynamic carriers of meaning and behavioral expectations. Professional identity is confirmed in the process of self-realization and verification [DOW 09] or by falsification of initial expectations, or changed expectations, similar to Schneider's [SCH 83, SCH 87, SCH 90] ASA theory. Thus, identity is formed by the dynamics of social interaction [GIO 98]. Identity works as a distinctive self-classification and simultaneously allows us to see ourselves as similar to a class of individuals with whom we associate or want to be associated [GIO 98, TAJ 86]. In line with this, Howard [HOW 00] stresses both social cognition and social interaction. Once an identity is adopted, it may be dynamically reproduced or reinterpreted [HOW 00].

People may simultaneously identify with multiple identities [THA 08]. They are not necessarily identified with all the groups to which they belong

or to all the roles they are called on to play. Identification can have multiple *foci* [DIC 04, HAR 05, KNI 00]. These can be centered on the career (at the individual level), the team, the organization or occupation (social level) [DIC 04]. Different processes in identification can include: (1) cognitive (knowledge of membership of a group), (2) affective (emotional attachment to a group), (3) evaluation (evaluative connotations both internal and external) and (4) different or similar behaviors [DIC 04]. Identification and commitment have different geneses: identification is contingent on the basis of a shared destination and perceived similarities with the organization, whereas commitment may be transactional, that is the material relationship between the individual and the organization [DIC 04]. When there is a change in context or in a comparison, individual or group identification can recalibrate [BAR 01, HOG 00].

A professional image is a mirror of professional identity, despite its complexity. Identities emerge from the interactions, negotiations and production of meanings, mediated by organizational contexts and interactions with internal and external audiences [CLE 07]. This process is one of creation rather than an ontological security. It defies stasis and predictability [CLE 05, CLE 07]. Career experiences provide the individual with objects and people that can lead to the stabilization of self-perceptions of identity or transformation into new identities [BEC 56]. Among the mechanisms that affect the participation experience and, consequently, the identity, we find: (1) the development of interest in the problems of the profession and pride in new skills, (2) the acquisition of a professional ideology, (3) internalization of motives and (4) the investment (level of effort in acquiring skills). Identification with work is affected by the following conditions: (1) connection to occupational title, (2) commitment to the tasks and (3) commitment to organizations or positions held [BEC 56].

1.5. Protean or boundaryless careers

Research on careers provides a bridge between cognitive and social levels of analysis [JON 07]. Institutional processes encode social knowledge of roles and role relationships. Then, these may come to be collectively shared and survive across generations [ZUC 77, JON 07]. Yet, these depend on perceivers, and may either be false or, in line with Popper's falsification principle [POP 59, OLI 12], may prove to be false over time, even if there is a lag between this occurring and either individuals or professions themselves recognizing it. This also relates to

perceptions and misperceptions, depending on less than conscious values, dispositions and beliefs [OLI 12, HOL 13].

Thus, there has recently been a disposition to presume that increased competitive pressures with globalization make workers more responsible for their path and necessarily proactive and adaptive [RAA 07]. This relates to two seminal metaphors in career literature: (1) the boundaryless career and (2) the Protean career. Collin and Young [COL 00a] submit that the concept of a boundaryless career is about flexibility, autonomy and self-determination. Brocklehurst focuses the notion of a career without boundaries in the discussion of identity, but questions the extent to which this is important in establishing or extending the sense of self [BRO 03].

Inkson [INK 04] has stressed limits to career metaphors while, in commenting on the metaphor of a "Protean" career, Arnold *et al.* [ARN 08] have observed that Proteus changed shape not by choice but to avoid capture, which also may be an increasing sense of being captured in either a boring, routine and alienating job or one that an engineer realizes is not fulfilling his or her potential since constrained by narrow job-fit rather than wider and higher level organization-fit. Thus, on the one hand, concepts of boundaryless or Protean careers may imply that a self-directed individual assumes control or that they have been constrained to change jobs either by the termination of a contract or by being fired [HAL 76]. Our approach relates this to the dynamics of Schneider's ASA theory in career choices [SCH 83, SCH 87, SCH 90]. Thus, we suggest that while someone may initially be attracted to select engineering as a career, its attraction may wane with time and that of management increase.

Heslin [HES 05a, HES 05b] has stressed change over time in terms of perceptions of career success. Thus, success can be at a particular moment, such as winning a contract, or over a longer time period, such as consistently doing so. Nicholson and de Waal-Andrews can also be defined in terms of personal recognition, or interpersonal comparisons, or other forms of success such as income [NIC 05]. Subjective evaluation of career success relates both to perception of others and a process of internalization [ART 05, VAN 77a]. Different social actors have different career aspirations and different valuations of success in terms of security, place of work, status, promotion, access to further education and training and work-life balance [NIC 05].

These also differ in relation to objective factors such as gender and ethnicity, whether the individual is a manager, a secretary or a technician and

it therefore would be mistaken to assume that all members of a given social or employment category share the same subjective career perceptions [BAI 89]. Moreover, there may be gender differences such as women preferring subjective evaluation of success whereas men prefer it in the perceptions of others such as recognized status and preferment [HES 05a]. This may also relate to the labor market. Highly specialized individuals with scarce skills may be more disposed to opt for career mobility when they sense or know that what they can offer is in demand [ARN 08]. This can also concern identity "regulation". Alvesson [ALV 01] has claimed that this relates to how employees are expected to govern themselves and to accept that they should be governed, such as: (1) identification with the organization as an institution, (2) cultural control and (3) standardized norms of behavior.

Governance implies power relationships and also merits a distinction between strategy and tactics. Some of the literature on boundaryless careers has conceptualized this as a positive strategic choice by individuals, whereas it may be a tactical reaction to negative experience. We suggest that this, and Schneider's ASA theory model [SCH 83, SCH 87, SCH 90], can be informed by Foucault's [FOU 72, FOU 77] case that power relationships can lie at any level within institutions and prove oppressive; such as a lower level manager with little to no knowledge of engineering assuming the right to command and instruct engineers in what may be a technical decision. With the qualification nonetheless of Foucault's case of power-knowledge in the sense that managers may have the power to support or inhibit innovative engineering, yet without engineering knowledge, whereas the engineers have the technical knowledge but lack the power to apply it and thus to innovate either products or processes according to Schumpeter [SCH 49], unless they become managers. Thus, they may wish to transcend constrained perceptions of job-fit by gaining professional qualifications as managers in the hope of being able to apply their own experience at higher operational and organizational levels.

Despite increasing recognition of the need for work-life balance [HIL 06], this may also constrain allegedly boundaryless or Protean career choices. Being either married or in a relationship with small children tends to imply more concern with family time, while this is also constrained by location such as needing not to work too far from schools [KIR 06] that also may mean forgoing a promotion. This is less the case for men, even if with downsizing and outsourcing they then may face the risk of being unemployed in mid-career, while women may then be at a double disadvantage in the sense that while they may still have a job, they may be on a "career plateau"

[KIR 06]. Whereas, on the other hand, there is some evidence that not having children, or being single, is associated with less career success for both men and women [THA 99] while, although pay is not the only factor in career choice [RYN 04], it cannot be disregarded.

1.6. Dialectics, dilemmas and career choices

In line with a dialectic between subjective and objective factors, Schein has qualified the concept of an "organizational career" and proposed instead the concept of an "internal career" as a sequence of experiences that may be linear, with an internal sense of being "anchored" and secure, or may be fragmented [SCH 96], while it may also be that "career anchors" and a sense of being "embedded" may be satisfied with what one has rather than risking a major career change, such as re-qualifying for a different profession. This suggests that the concept of a career, and of career choice, also needs to take account of the interdependence of subjective perceptions and objective indicators of success, such as not only wanting a wider range of experience and responsibility, and to "move on" but also realizing that one has reached a ceiling within an organization and has nil or near to nil chance within it of being able to "move up".

Nonetheless, some researchers continue to assume that career success relates to upward mobility on an internal career ladder [ART 05]. This tends to assume not only stable careers but also stable organizations, whereas their stability with globalization, downsizing, outsourcing and business re-engineering for some time has been in question. Moreover, according to Arnold and Cohen career success depends both on performance and the social position of the individual [ARN 08]. Claiming support from Judge *et al.* they submit that there is more evidence supporting the role of social position than that of performance [JUD 04]. Pay levels and promotions relate to objective success, whereas subjective success concerns career satisfaction [JUD 04].

Doyle [DOY 00] has stressed the need to avoid mechanistic models of career management in favor of more holistic and integrated approaches. According to London [LON 93], career motivation is a multidimensional construct embodying at least three factors: (1) capacity to adapt to different circumstances and acceptance of risks; (2) realism in terms of clear objectives related to self-knowledge of one's own capacities and challenges; (3) identity, in the sense of the degree to which an individual can be symmetrical with both the demands and needs of a job and of the organization.

There is also the distinction between know-how and know-whom. Know-whom is important both for traditional and boundaryless careers, and in smaller institutions such as family firms, whereas know-how is more job related [ART 95]. Table 1.1 represents the comparison between traditional and Protean careers [DEF 94, HAL 04].

	Traditional career	Protean career
Boundaries	One or two organizations	Multiple organizations
Identity	Employer dependant	Employer independent
Relationship	Job security	Employability for performance and flexibility
Competences	Organization specific	Transferable
Measures for success	Salary, promotion and status	Psychologically meaningful work
Career management responsibility	Organization	Individual
Key attitudes	Organizational commitment/involvement	Work satisfaction and professional commitment/involvement

Table 1.1. *Adapted from [DEF 94] and [HAL 04]*

Self-directed careers can be of three types: (1) positioning, through accumulated contacts and experiences, intended to yield a given result; (2) gaining influence with other members of an organization and (3) opening new frontiers [KIN 04]. According to Kanter's concept of a portable career, a successful individual can carry or transfer this either elsewhere in an organization or to another organization [KAN 89]. Arnold and others have also seen careers in terms of a theory of action planning [ARN 06, RAA 07], related positively with career satisfaction [RAA 07].

Ashforth and Mael [ASH 89] identify four factors related to group identification that may be related to career embeddness or career anchors: (1) group values and practices, (2) group prestige and the degree to which this may enhance for an individual, (3) in-groups and out-groups in terms of social frontiers and (4) group dynamics in terms of interpersonal interactions, similar values, the sharing of aims or responses to threats.

1.7. Case study, sample and data analysis

A sample of 315 engineers voluntarily answered a web-based online questionnaire survey. They all belonged to the Portuguese Society of Chartered Engineers, affiliated with the Portuguese Centre Regional Committee. There were no previous restrictions or cohorts. The mean age was 36.74 years (standard deviation (SD) = 8.99 years). The sample consisted of 51.4% female respondents and 48.6% male respondents. All the respondents worked at the time the questionnaires were answered. However, 13% did not work as engineers. Of the participants, 9.3% were self-employed, 84.5% worked on behalf of others and 6.3% worked as independent workers or had mixed situations. Of the respondents, 47.6% said they held a management position and 52.4% did not have a management position.

The questionnaire items evaluating the research questions were developed from the existing research. The items were translated into Portuguese by the research team and back-translated to English by a professional translator to check for bias. The pre-testing of the questionnaire was made online and it was applied to the targeted population; data analysis was done in the Statistical Package for Social Sciences (SPSS) 21 software. We adapted the professional identification (PI) scale developed by Hekman [HEK 09] by substituting doctors for engineers and reversed the scale (1 = "disagree completely" to 5 = "agree completely"). The professional commitment (PC) scale developed by Meyer *et al.* [MEY 93] consists of an 18-item measure of affective, continuing and normative occupational commitment (six items in each scale). The items were modified to apply to the engineering profession (1 = "strongly disagree" to 7 = "strongly agree").

The engineers and managers relationship scale (EMRS) was previously used in studies comparing engineers and marketers [SHA 98, SHA 03]. Eleven items were used and modified to apply to the engineering profession compared to managers in general. Participants responded to each of the measures using a five-point-type Likert scale ranging from –2 (strongly disagree) to 2 (strongly agree). The perceived comparative status (PCS) scale comparing managers and engineers was created using eight variables: (1) salary, (2) social status, (3) amount of work, (4) career perspectives, (5) job security, (6) job interest, (7) job satisfaction and (8) autonomy (with a five-point scale ranging from much better, better, equal through to worse and much worse).

1.8. Results

1.8.1. *Professional identification (comparison group)*

When questioned about the professional group suitable for comparison with engineers' work and careers, 32.71% of the respondents referred to managers. References to other engineers come second to references to managers (Table 1.2).

Professional group for comparison*	Valid (%)
Managers	34.65
Other engineers from other sectors	14.52
Architects	14.52
Lawyers	11.88
Doctors	8.58
Public sector employees	6.60
Economists	4.62
Others	4.62

*Valid percent excluding "none" = 12.53% and "all" = 4.90%.

Table 1.2. *Professional groups mentioned by comparison*

1.8.2. *Mediating effect of the perceived comparative status*

The concept of mediation implies the assumption of causal relationships between the variables involved. A mediator variable is one that in the regression equation decreases the magnitude of the relationship between an antecedent variable and a dependent variable or criterion. There are both scope and limits to this. Dunlap and Landis [DUN 98] have found that building internally consistent measures that include multiple dimensions correlated with the same construct can lead in some cases to excluding important variables in explaining the focused variable. In these cases, it is safer to use statistical techniques such as multiple regression.

We performed a hierarchical multiple regression to describe the relation between PI and PC and study the mediating effect of the PCS. The beta

scores (Figure 1.1) indicate that PCS partially mediated the relationship between PI and PC.

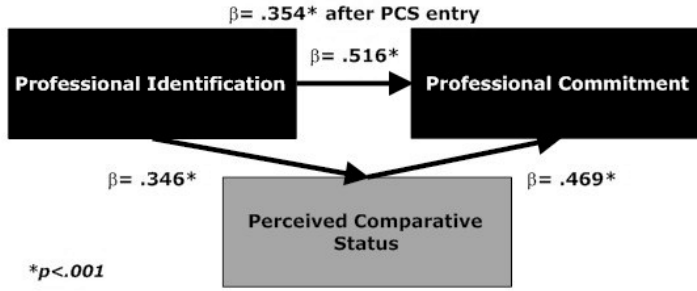

Figure 1.1. *PCS mediating effect on PI and PC*

Recoding the PCS construct in negative, equal and positive and using the one-way analysis of variance technique for comparing the PC provided the following results: the Levene's test of homogeneity of variances (2.601; sig = 0.076) enabled the use of the Scheffe's *post hoc* analysis (Table 1.3):

Dependent variable: professional commitment

Perceived comparative status	Mean difference	Significance	95% Confidence interval		
Negative	Equal	–0.801	0.000	–1.193	–0.408
	Positive	–0.534	0.000	–0.727	–0.342
Equal	Positive	0.266	0.292	–0.150	0.683

Table 1.3. *One-way ANOVA of professional commitment segmented by the recoded PCS*

The mean difference between the PC of those engineers who feel a negative comparative status is statistically significant from those who feel the status as equal or positive (favoring engineers). This adds confidence on considering PCS a mediator of PC.

The recoded PCS construct reports 72.7% of the respondents as feeling negatively affected (Table 1.4).

		Frequency	Percent
Perceived comparative status	Negative	229	72.7
	Equal	14	4.4
	Positive	72	22.69
	Total	315	100

Table 1.4. *Isolated variables of the PCS*

The analysis of the isolated variables of the PCS construct is also interesting, as shown in Table 1.5.

	Negatively unbalanced (%)	Neutral (%)	Positively unbalanced (%)
Salary	**83.5**	13.3	3.2
Social status	**50.5**	39.1	10.4
Workload	37.5	**48.9**	13.6
Job security	37.1	**38.1**	24.8
Interesting job	13.7	35.9	**50.4**
Work satisfaction	19	**54.7**	26.3
Autonomy	29.5	**48.6**	21.9

Table 1.5. *PCS (frequency table)*

Salary and social status are the most negatively unbalanced indicators. Having an interesting job is considered positively balanced by a short majority of the respondents (50.4%).

1.8.3. *Management training/education*

Testing for the independence of the variables (1) having had training in management and (2) being a manager results in a Pearson Chi-square of 0.256 (sig>0.05), suggesting that not only actual managers have had the

training. Of the overall respondents, 35.2% have had some form of training or a course on management and 86% of them did this through personal initiative.

Management training/education	Decision maker	Reason
Yes (35.2%)	Me (94.6%)	Develop competences for the current job (23.16%)
		Develop competences for a new job (76.84%)
	My employer (5.4%)	Develop competences for the current job (93.75%)
		Develop competences for a new job (6.25%)
No (64.8%)	–	–

Table 1.6. *Management training/education, decision and reasons*

The results (Table 1.6) indicate that 35.2% of the engineers have had training or a management course and that this was done mainly by personal initiative. The reasons for entering a course in management are completely opposed when segmented by the decision-maker: when the decision is made by the employee, it is intended for a new job and thus related to an effective career move; when the decision is made by the employer, it is intended for the developing of competences in a current job.

1.8.4. *Relationship between engineers and managers*

A principal components analysis with a varimax rotation was performed on the engineering and management relationship scale (EMRS) in order to explore the data (exploratory factor analysis (EFA)) and assess the construct validity of the study measures. The subjects to variables (STV) ratio is >20:1 (n = 315 and variables = 11) permitting the use of this statistical option.

Results of the principal components analysis yielded four factors (factor 1: eigenvalue = 3,184; factor 2: eigenvalue = 1,984; factor 3: eigenvalue = 1,307 and factor 4: eigenvalue = 1,168), explaining 69.51% of the total variance. The measures for sampling adequacy (MSAs) indicate the

possibility of using the data for EFA (KMO = 0.664; Bartlett's test of sphericity sig = 0.000).

The interpretation of the factors is shown in Table 1.7.

Factor	Variable	Loading	Interpretation
1	Cultural differences exist between engineers and managers	0.852	Communication and culture
	It is difficult for engineers to communicate effectively with managers	0.656	
	Cronbach's alpha = 0.654		
2	Engineers and managers should work together to solve problems	0.804	Engineering and management integration
	Teamwork between engineers and managers should be encouraged	0.740	
	Engineering and management should be closely integrated	0.605	
	Management and engineering are two completely separate functions	0.558	
	Cronbach's alpha = 0.696		
3	Engineers and managers do not understand each other	0.825	Status and conflict
	Engineers are more important to a company than managers	0.736	

Table 1.7. *Factors and interpretation*

	Engineers and managers should have equal status	0.637	
	Cronbach's alpha = 0.617		
4	All engineers should know something about management	0.750	Knowledge and trust
	Engineers and managers cannot trust each other	0.652	
	Cronbach's alpha = 0.226		

Table 1.7. *(Continued) Factors and interpretation*

There are four interpretable factors: (1) communication and culture, considering the cultural differences and communication issues; (2) engineering and management integration, considering the acknowledgement of two different disciplines that can be integrated; (3) status and conflict, including the power relations and role importance; and (4) the relationship between knowledge and trust.

When analyzing the descriptive statistics of variables like the perceived cultural difference (Table 1.8), we find that 65.4% of the respondents acknowledge such differences, 21% are neutral and only 13.7% disagree. Interestingly, when segmented by those who are currently in a managing position or not, engineer-managers perceive this difference even further, with a relative frequency of 81.4%.

The variable "it is difficult for engineers to communicate effectively with managers" also has interesting results in terms of differences between engineer-managers and engineers who are not managers. Of the engineer-managers, 28.7% consider that effective communication is not difficult; on the contrary, 44.8% of the engineers who are not managers consider the difficulties to be true.

Table 1.9 shows that more than four-fifths of the respondents (84.4%) disagreed that management and engineering are two completely separate functions. Nonetheless, 91.7% of the respondents also disagreed with the statement "All engineers should know something about management". This high number diverges from more than one-third of engineers seeking training in management in order to qualify for a new career.

Cultural differences exist between engineers and managers		Frequency	Percent
Currently in a direction or management position?	Totally disagree	1	0.7
	Disagree	12	8.0
	Neither agree nor disagree	15	10.0
	Agree	97	64.7
	Totally agree	25	16.7
	Total	150	100.0
Currently not in a direction or management position?	Totally disagree	3	1.8
	Disagree	27	16.4
	Neither agree nor disagree	51	30.9
	Agree	68	41.2
	Totally agree	16	9.7
	Total	165	100.0

Table 1.8. *Frequency table for the variable "cultural differences exist between engineers and managers"*

		Frequency	Percent
Management and engineering are two completely separate functions	Totally disagree	87	27.6
	Disagree	179	56.8
	Neither agree or disagree	16	5.1
	Agree	29	9.2
	Totally agree	4	1.3
	Total	315	100.0

Table 1.9. *Frequency table for the variable "management and engineering are two completely separate functions"*

1.9. Discussion and conclusions

Exploratory proposition 1: engineers perceive cultural differences along with unbalanced status between engineers and managers.

The data in the case study support the proposition. Cultural differences in status are acknowledged by 65.4% of the overall respondents and 81.4% of the engineer-managers. These data suggest a deeper assumption that professional identities are different and those engineers who have a management position reinforce the idea that they have entered a different world where probably some professional identity redefinition is needed. The PCS construct highlights the concept that engineers feel underprivileged in accessing objective (or indirectly subjective) indicators like: (1) salary, (2) social status, (3) amount of work, (4) career perspectives, (5) job security, (6) job interest, (7) job satisfaction and (8) autonomy. Salary and social status are the most negatively unbalanced indicators (83.5% and 50.5% of the references, respectively).

Exploratory proposition 2: Foucault's theory of power-knowledge can be qualified in terms of managers having power but engineers having knowledge.

This relates to the proposition that an engineer can become a manager but a manager cannot become an engineer. Results show that 35.2% of the engineers in our sample perceive the need to formalize management knowledge by entering management courses, and this intended behavior is self-directed in the sense of Riesman [RIE 50, RIE 54] and aimed at a future career change. The analysis shows that there are four related factors: (1) perceptions of status, (2) engineering and management integration, (3) role importance and (4) divorce between knowledge and power. This qualifies Foucault's [FOU 72, FOU 77] equation of knowledge and power in the sense that it is engineers who have technical knowledge yet managers have power, including the power to support or inhibit innovative engineering [OLI 13].

Exploratory proposition 3: Schneider's ASA theory is relevant to engineers initially being attracted to engineering as a profession but then wishing to avoid narrow job-fit by qualifying as managers.

More than one-third of the respondent engineers perceived the need for training in management. It was also found that PCS partially mediated the relationship between PI and PC. This is combined with the results showing that 94.6% of the engineers who have had training in management decided to

do it for themselves in a manner consistent with Riesman's self-direction [RIE 50, RIE 54] and that 76.8% of them did it to develop competences for a new job as either an internal or an external career move. Of the respondents, 72.7% perceived engineering as a negative status when compared to that of management. This supports the extension of the Schneider [SCH 83, SCH 87, SCH 90] ASA theory from personnel selection and choice to the attraction of a career move, following attrition in engineers experiencing that they have knowledge but managers have power. The attraction proposition is also supported in terms of data on salary and social status.

Exploratory proposition 4: this has implications for differing perspectives on boundaryless or Protean careers.

It has been noted earlier that Arnold *et al.* [ARN 08] have observed that Proteus changed shape not by choice but to avoid capture, which may also be an increasing perception, sense or feeling of being captured in a role that an engineer realizes does not fulfill his or her potential since constrained by narrow job-fit rather than the less bounded and constrained higher level management roles. The findings indicate that this may be among the reasons why engineers now, even if not conscious of the precedents, are seeking to regain the earlier role of engineer-managers.

1.10. Strengths and limits

One of the strengths of the sample, which is broad in itself, was that it was near to equally gender balanced. Another strength of the sample was that those of the engineers holding a management position and those who did not were also near to equally balanced. One of its limits was that it was confined to Portuguese engineers. Another limit was that it did not seek to include ethnicity even if Portugal is not a notably multi-ethnic society.

An innovative strength of the method was that the new PCS construct enhanced the understanding of engineers' perceptions of managers and the relationship between PI and PC. One of the limits of the hierarchical regression technique, although this is shared by any regression analysis, is that this only correlates rather than identifies causality. Another limit was that, although the study was gender balanced, it did not allow for gender differences in perceptions, or relate these to changing needs in work-life balance and the degree to which these may influence opting for management training or education in terms of career choice.

However, there were several remarkably strong findings such as that nearly 73% of the engineers felt themselves to be negatively affected in terms of PCS with managers. Also, that when engineers undertook further education in management, this decision in more than 94% of cases was their own rather than that of the management, while nearly 77% of the engineers decided to do so to develop competences for a new job rather than their current job.

1.11. Implications for future research

Future research on the careers of engineers and their choice to qualify as managers could well be longitudinal in the manner recommended by Arnold and Cohen [ARN 08] and be interview-based rather than only questionnaire-based. It also could assess the degree to which there is a scope, as suggested in two of the exploratory propositions, for extending and assessing the Schneider [SCH 83, SCH 87, SCH 90] ASA principle from personnel selection to career choice as well as assessing the relevance of Foucault's [FOU 72, FOU 77] concept of power-knowledge in terms of how engineers have technical knowledge yet managers without expertise in engineering may exercise power in a manner that directly or indirectly encourages engineers to become managers.

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