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# 学生党建对象过程考察指标体系的构建

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【摘要】 高校大学生党建工作对大学生综合素质的提高和高校思想政治工作均起到重要的导向性作用。构建了能够反映党员发展特点的党建对象考察指标体系,并在此基础上提出了考察的基本理念,力求为客观、全面地评价党建对象奠定基础,从而为党员发展工作提供科学、直观参考。

【关键词】 大学生;党建对象;过程考察;指标体系

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## 一、大学生党建对象过程考察指标体系构建的原则

学生党建对象过程考察指标体系是学校发考察标准,也是对学生进行共产主义教育重要依据,对高校学生党建工作以及学生基础性指导作用。因此,大学生党建考察指标体系构建必须充分体现党的教育发展的要求,并在此要求下遵循以下原则。

全面性原则。大学生各方面素质是一个广的系统,对其进行评价不是一两个指标就能貌的。因此,大学生党建对象过程考察指标构建必须坚持全面性原则,将能够反映与要求相关的学生素质的指标进行合理的整合具有互有内在联系的若干组、若干层次的指标以客观、全面反映学生素质不同层面和侧面体系。同时,对党建对象的大学生,评价的每尽可能边界分明,避免相互包含,从而减少内容进行重复评价。

差异化原则。没有比较,难辨优劣。大学人中文化程度高的群体。但是在教育过程培养对象的素质不尽相同,以及受教育的环境不同,不同学校、不同专业以及同一专业不同学生的成长要求也不尽相同,因此,强调大学生党建对象过程考察指标体系构建的差异化原则在充分体现对党建对象学生的政治素养、思想共性要求的基础上,还要体现对不同学生

群体的不同要求,保证不同群体考评的差异化和同一群体考评的可比性。

(三)目标导向性原则。对党建对象的评价目的并不是单纯地评出名次和优劣,确定党员发展人员,更重要的是引导和鼓励被评价学生朝着正确的方向和目标发展。这就决定了在构建大学生党建对象过程考察指标体系时必须充分体现目标导向原则。学生党员的考察、培养和发展工作是高校贯彻党的教育方针,培养具有共产主义觉悟的社会主义建设者和接班人的重任,在指标体系的设置上必须充分体现与此重任的一致性,充分反映党员发展要求。同时,为了区分不同要求的重要程度,可以采用设置权重方法,以引导学生的努力方向和重点,从而实现目标导向性功能。

## 二、大学生党建对象过程考察指标体系的构建

构建科学、合理的指标体系是对大学生党建对象进行过程考察,并激励学生朝着正确的方向积极向党组织靠拢的基础。大学生党建对象过程考察指标体系必须能够充分体现《党章》对学生党员发展的要求以及大学生在校成长的规律,并能确保考察结果的科学有效性。为此,本研究从软性指标  $U_1$  和硬性指标  $U_2$  两方面构建大学生党建对象过程考察指标体系。

软性指标  $U_1$  主要立足于对学生的政治素质、思想素质、道德素质等内在素质的要求。此类指标体系可以通过调查问卷、座谈面谈等方式获取考评主体的评价意见,并加以科学的加工处理,形成最终的

评价结果。而硬性指标  $U_2$  则是反映学生在校期间的学习、学术、获奖情况等量化成绩,此类指标可以采用统计归纳的方式加以考核,比较直观。由此思路所构建的大学生党建对象过程考察指标体系如表1所示。

表1 大学生党建对象过程考察指标体系

分类层	要素层	指标层	数据来源或数据计算	权重
软性 指标 $U_{11}$	政治素质 $U_{11}$	同要素层	调查问卷、座谈面谈	$W_{11}$
	思想素质 $U_{12}$	同要素层	调查问卷、座谈面谈	$W_{12}$
	道德素质 $U_{13}$	同要素层	调查问卷、座谈面谈	$W_{13}$
	能力素质 $U_{14}$	同要素层	调查问卷、座谈面谈	$W_{14}$
	身心素质 $U_{15}$	同要素层	调查问卷、座谈面谈	$W_{15}$
硬性 指标 $U_2$	学习成绩 $U_{21}$	见附表1	统计值	$W_{21}$
	学术成绩 $U_{22}$	见附表2	统计值	$W_{22}$
	课外活动 成绩 $U_{23}$	见附表3	统计值	$W_{23}$
	社会工作 获奖 $U_{24}$	同要素层	统计值	$W_{24}$

表中,软性指标  $U_1$  的五个要素指标是学生的内在素质,为了避免指标体系中指标间的重复性,将不再进行细分。在考察中将坚持群众参与性和师生互动性原则,兼顾辅导员、班主任、同学等方面的意见,并运用相应的数学方法,对这些意见进行必要的整合和处理,从而实现主观向客观的转变。硬性指标共有四个要素层,为了统计方便,对部分要素层进行了细化和分解,指标层分别见附表1、附表2、附表3。

附表1 大学生党建对象过程考察学习成绩指标体系

学习成绩 $U_{21}$	指标层	权重
	主修课程成绩 $U_{211}$	$W_{211}$
	辅修课程成绩 $U_{212}$	$W_{212}$
	外语水平 $U_{213}$	$W_{213}$
	计算机水平 $U_{214}$	$W_{214}$

附表2 大学生党建对象过程考察学术成绩指标体系

学术成绩 $U_{22}$	指标层	权重
	论文发表 $U_{221}$	$W_{221}$
	科技活动获奖 $U_{222}$	$W_{222}$
	科技创新与申请专利 $U_{223}$	$W_{223}$

附表3 大学生党建对象过程考察课外活动成绩指标体系

课外活动成绩 $U_{23}$	指标层	权重
	文化活动获奖 $U_{231}$	$W_{231}$
	文学/宣传作品 $U_{232}$	$W_{232}$
	社会实践活动获奖 $U_{233}$	$W_{232}$

本指标体系是从系统全面性、简明科学性、稳定可比性等原则出发,经比较和筛选国内有关论点,集中突出大学生发展入党要求的共性所建立的。对于不同专业、不同年级学生的评价,可以从这些共性中借鉴思想和方法,结合学生群体的特点,增加和改变相关指标,以提高过程考察的针对性。在某些硬性指标考评中,应根据可能出现的各种情况,制定相应的考评标准,以增强考评工作的可操作性,譬如对指标外语水平  $U_{213}$  的评价可以制定此考评标准,外语水平得分  $F_{213} = \text{百分制得分} + X + Y$ ,其中: $X$  为英语考试等级的附加值、 $Y$  为通过年级的附加值。 $X$ 、 $Y$  的取值可以根据不同专业对英语能力的要求加以确定,以体现要求在等级和时间上的层次感,但必须保证同一类学生考评标准的一致性。

### 三、大学生党建对象过程考察的基本理念

(一)科学处理评价指标。本研究所构建的大学生党建对象考察指标体系包括定性指标和定量指标两个方面。定量能够科学反映考察的刚性指标,避免考察的主观性和任意性;定性可以反映考察的柔性指标,增强考察的全面性。为了实现量化考察的要求,以提高考察结果的明朗性和可比性,对于定性部分的指标必须借鉴模糊数学等数学方法以实现定性向定量的科学转变。

(二)重视考察结果的处理和反馈。对大学生党建对象的考察不仅仅是为了确定学生的全面成绩,其另外一个重要的目的就是帮助学生找出其在各方面的优势和不足,这就决定了必须重视考察结果的反馈工作。同时,为了增强考察结果对学生指导的针对性,必须将考察的最终结果分解至主要指标上,附带相应改进建议,以反映该学生考察结果形成的过程以及今后的努力方向和方法。

(三)关注学生进步率。学生是受教育者,其成长都有一个过程。所以,必须用发展的眼光来考察学生。传统的考评就是将考评客体本阶段的考评结果进行排序与等级划分。这种方法比较简单,但是忽略了考评客体的进步率,不能达到考评应有的激励效果。本研究认为应该将学生考察结果的进步率纳入总分排名,建立如下的排名公式: $L = \alpha L_1 + (1 - \alpha) L_2$

式中: $L$  为最终结果排名; $L_1$  为当年考察结果排名; $L_2$  进步率排名。 $\alpha$  为进步率系数,根据对进步率的要求来定,如果要求较高, $\alpha$  的取值较小;如果要求较低, $\alpha$  的取值较大( $0 < \alpha < 1$ )。

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# 有效搭建校企互动平台 着力推进政产学研发展

## ——南京航空航天大学民航学院政产学研合作实证分析

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**摘 要:**高校政产学研结合是高校与政府和行业开展互利共赢的产学研合作教育的一种有效形式。南京航空航天大学民航学院从实施董事会管理体制,搭建政产学研合作的有效组织载体;主动面向民航发展的人才需求,全面优化育人模式;发挥董事会的体制优势,推进校企全方位深度合作等层面开展政产学研合作。进一步有效提高政产学研的合作应从有效构建政产学研组织载体,实现互利共赢,强化管理的协调性等方面入手。

**关键词:**校企互动;政产学研;合作

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党的十七大报告提出,要“加快建立以企业为主体、市场为导向、产学研相结合的技术创新体系”。政府宏观管理、学校面向社会自主办学,是高等教育体制改革的目标。政产学研合作已经成为促进教育、科技与经济体系有机结合、协调发展的有效手段,积极探索政产学研相结合,不仅是高等教育的方针、政策,更是社会发展的时代特点和普遍规律。

### 一、高校政产学研合作的内涵及必要性分析

#### 1. 高校政产学研合作的历史脉络及内涵

政产学研结合是指政府、企业、高等院校或科研院所等主体要素为了共同的目标和利益,充分发挥各方优势而形成的互惠双赢的合作关系。政产学研合作不仅是市场经济与知识经济相结合的必然产物,更是国家创新体系的重要组成部分,其思想早已存在:1862年威斯康星大学率先提出“社会服务”职能,象牙塔里的高深知识研究者们开始逐步关注社会经济发展。自从赫尔曼·施奈德于1906年在美国辛那提大学推行了第一个合作教育计划以来,产学研合作教育引起了社会的广泛关注。在近代,政产学研合作在外国的发展过程中逐步探索出行之有效发展模式,尤以德国的“双元制”、美国的“合作教育”、英国的“工读交替”、日本的“产学合作”和澳大

利亚的“技术与继续教育”等模式为世人所称道。<sup>[1]</sup>在我国,20世纪80年代末开始开展合作教育,1997年10月教育部确定“九五”期间,在全国28所高校开展产学研合作教育的试点工作。由此,产学研合作教育正式纳入了政府教育部门教育改革的总体规划中。2007年11月3日,在北京正式成立了中国产学研合作促进会,预示着我国产学研合作工作将加大力度向高层次发展。<sup>[2]</sup>

政产学研结合是随着社会经济和科技的进步而发展起来的、以政府有关部门参与下的高校和企业两种不同的教育环境和教育资源的联合为内容,进行概念、模式和效益分析,提高高校的社会服务能力和发展经济的一种合作模式。<sup>[3]</sup>现代意义上的政产学研合作强调以政府为引导、企业为主体、市场为导向、院校为依托,其实质是知识的再配置和政府、企业、高校职能的再塑造。就此意义而言,政产学研存在着相互依存、螺旋上升的本质联系,<sup>[4]</sup>产通过学而现实应用、通过研进行升级换代,研依存于学的现实支撑与产的实际需求,而学紧密联系物质生产和科技新成就即产和研。政府、企业、高校职能的再塑造则强调政府、企业和高校的有效协调,政府重引导和服务、企业重主导和需求、高校重对接和应用,落脚于三者的协同效应。

#### 2. 高校政产学研合作的必要性分析

高校是我国高层次创新人才培养的重要基地,

是我国基础研究和高技术领域原始创新的主力军,是实现技术转移和成果转化的发源地。相对于企业和其他科研机构,高校具有学科门类齐全、研究力量雄厚、学术氛围宽松自由、信息畅通前瞻等优势特点。但是,离开和社会和行业充分接轨的高校也存在人才培养的导向性缺失、教学内容和培养模式一成不变、科研力量分散、科研经费不足、研究成果转化率低下等发展的瓶颈。长期以来,由于历史和现实的诸多因素,我国的科技、教育和经济始终未能紧密结合、无缝对接,政产学研水平较低,导致了创新资源使用的低效和产业发展动力的不足,并成为制约经济社会发展的重要瓶颈。

21 世纪的头 20 年,是我国改革发展的重要战略机遇期。面对世界范围内日新月异的科技进步和日趋激烈的国际竞争,党和国家作出了大力增强自主创新能力、建设创新型国家的战略决策。在新的发展形势下,高校的政产学研合作具有更高的发展要求和更广阔的发展空间。从高校外部来看,创新型国家建设所大力推进的自主创新给政产学研合作带来了更深层次的要求。由于目前我国企业的自主创新能力尚不足,在很长的时期内,高校在企业自主创新进程中将继续发挥重要作用,大学与产业的联系是国家创新体系中最核心、最关键的子系统。同时,随着全球化、信息化与开放创新的进一步发展,大学在国家创新体系中的作用更将与日俱增。从高校内部来看,加强政产学研合作是高校提高发展质量,提升服务经济社会发展能力,实现可持续发展的重要途径。

### 三、高校政产学研合作实践探索之实证分析

高校政产学研合作的研究与实践在国际上,特别是在发达国家如美国,日本已有一定的历史,并取得了良好成效。我国高校在政产学研合作方面也开展了实践与探索,但由于我国的经济体制和教育体制在深化改革过程,新旧制度之间、各个利益主体之间不可避免地产生磨擦和不协调,参与合作的主体在价值取向和目标要求上存在着差异等诸多因素制约了政产学研合作的有效开展。如何寻求有效的政产学研合作运行机制是关键。

政产学研合作组织模式多种多样,选择什么样的合适的模式、采取怎样的运行机制是关系到政产学研合作成败的问题。南京航空航天大学民航学院在开展政产学研合作过程中,根据合作主体的特

点,坚持互利互惠、市场导向、开放化等原则,选择合作模式和采取适合的运行机制。

20 世纪 90 年代,南京航空航天大学作为一所具有国防科技特色的中央部属全国重点大学,面对中国民航事业大发展机遇,学校充分发挥已有的人才和智力优势,积极争取上级主管部门和民航企事业单位的支持,拓展服务面向,高起点跻身民航科教事业。自 1993 年创办以来,南京航空航天大学民航学院坚持“立足民航,依靠民航,服务民航”的开放办学型思路,建立和实施了董事会管理体制,走出了一条政产学研合作办学的新路子,在有效促进我国民航事业快速发展的同时,也实现了学院的跨越式发展。

#### 1. 实施董事会管理体制,搭建政产学研合作的有效组织载体

高校的政产学研,离不开政府的引导,离不开企业的主导。为了充分发挥民航管理部门、民航企事业单位和我校的协同效应,1994 年 5 月,在中国民航总局的指导下,民航学院正式成立了以民航骨干企业为主体的董事会,制定了董事会章程,进一步明确了企业和学校的权利与义务,规范了合作机制、校企联合办学的运作方式。根据章程规定,董事会是对南航大民航学院建设和发展中的重要事务进行决策、咨询、评议、审议和指导的机构,主要职责包括:对民航学院的办学目标、办学方向、办学规模等战略发展定位进行审议、指导和决策;对学院的学科与专业建设、招生与就业、科学研究、科技开发、管理和改革、基础设施建设等建设发展中的重大事项提供决策咨询和监督指导;根据民航事业发展对人才的需求,结合董事单位的人才需求标准,审议学院人才培养计划和方案;本着互惠互利的原则,联络和督办合作教育培养事宜,促进和开展校企双方的人才培养、在职进修、培训以及学历教育;积极推动和促进与董事单位的科技交流合作、科研项目研究以及科研成果开发、转化和应用。十多年的实践证明,董事会管理体制作为南京航空航天大学 and 民航管理部门、民航企事业单位间的桥梁和纽带,为发挥民航管理部门在政产学研中的引导作用,民航企事业单位的主导作用以及高校的主体作用提供了有力支撑,已成为政产学研合作的有效组织管理载体。

#### 2. 主动面向民航发展的人才需求,全面优化育人模式

人才培养是高等学校的第一职能。高校主动适应企业需要,以及高校必须凭借自身的优势与特色为企业提供有效的人才服务,这是新时期高校与企

业产学研合作的重要基础与前提。立足民航发展对高素质人才的最紧迫、最现实需求,坚持校企协调互动,共同找到最佳的结合点,推进人才培养模式改革与创新,增强人才培养的针对性和有效性,是民航事业发展对南京航空航天大学政产学研提出的最重要的课题之一。为此,学校反复深入民航企业调研,详细了解单位用人需求,客观研究办学资源,及时优化人才培养方案,细化专业培养目标,设置明确的专业方向。在“交通运输”专业内,细化了交通运输管理、机务工程、民航电子电气工程、空中交通管理与签派等专业方向,积极开展了“适航管理”等辅修或第二专业修读;为满足民航事业发展对飞行、空管、机务人才的特殊需求,采用“2+2、3+1”等分流培养模式开展人才培养服务。为满足行业对高层次人才需求,面向民航企事业单位开展了工程硕士班、博士班、在职培训等人才培养服务,形成了学校积极面向企业开展人才服务、企业热情支持学校人才培养的双向互动良性循环。在毕业生跟踪调查中,各用人单位对学校人才培养质量给予了高度评价,普遍反映民航学院的学生行业契合度高、应用性强、发展后劲足,思想和业务素质好。此外,学校积极与各董事单位开展双向人才交流,选拔了一批优秀中青年骨干教师到民航企业一线开展科研合作和挂职锻炼,先后选派近百名博士生、硕士生到各董事会单位开展科技交流,大部分研究生的论文选题都来源于董事单位的实际问题,起到了很好的“双向交流、推动实践”作用。

### 3. 发挥董事会的体制优势,推进校企全方位深度合作

现代意义上的政产学研结合不仅是目标统一、责权分明的过程,更是相互依存、各方收益的过程。在董事会模式下,各董事单位对民航学院的成长和壮大给予了大力的支持。据统计,从1994年至2009年间,各董事单位直接投资学校民航教育的经费达4000余万元,捐赠航材价值1500余万元。在经费和实验设备支持下,显著改善了学校的教学科研条件。加强学科建设是民航学院在更高层次为企业提供人才服务的客观需要。在董事会的指导和支持下,学校大力加强民航类学科专业建设,建成了民航系统内唯一的一个一级学科“交通运输工程”博士学位授权点和博士后流动站,同时建立了交通信息工程及控制、交通运输规划与管理等四个二级学科博士点、五个硕士点、三个专业硕士学位授权点及七个本科专业及方向,成立了航空安全与报障技术研究所、空中

交通管理研究所、交通信息工程研究所、民航软科学研究所等四个研究所,形成了能够满足民航行业主要方向的学科专业体系和人才培养体系。此外,为满足行业对高水平科学研究的迫切需求,学校依托以项目合作形式为董事会单位提供畅通的科研服务。近几年,围绕民航安全、空管、航空运输规划与管理、民航信息化建设等领域和方向,与各董事会单位开展科技合作100余项,科研经费达2000余万元,有效推动了民航企业的技术创新,实现了校企的合作共赢。

## 四、进一步推进高校政产学研合作有效运行的思考

从政产学研发展历程及现状来看,高校政产学研合作需要理论支撑,更需要实践指导,只有在实践中不断总结经验、创新方式,才能推动高校政产学研合作取得实效。通过对高校政产学研内涵理解和新形势下必要性分析,结合对上述实例的考察和分析,我们认为,高校政产学研合作发展需要把握以下几个方面。

### 1. 构建政产学研组织载体是实现高校政产学研的重要基础

政产学研组织载体是联系政产学研合作主体各方的桥梁和纽带,具有相对稳定性、长期性等特点。教育部《关于加快研究型大学建设,增强高等学校自主创新能力的若干意见》指出,要“鼓励研究型大学积极与企业合作,构建产业技术创新联盟”。构建政产学研组织载体是实现政产学研由传统的松散型向紧密型过渡的重要基础,反映了各方对稳定型合作关系的需求,有利于政产学研从以往的技术转让、联合攻关等单一合作,发展为政府引导,校企共建研发机构,共建产学研经济实体,共建人才培养基地等多种模式,从而有利于政府、企业与高等院校结成“战略联盟”。

### 2. 实现互利共赢是高校政产学研成功的重要保障

政产学研是途径,实现互利共赢是目标。所以,互利共赢是维系高校政产学研成功的重要保障。在政产学研合作中,坚持互利共赢的原则非常重要。虽然在合作过程中政府、企业、高校处于不同的地位,发挥着不同的作用,但政产学研合作需要各方产生效益,只有这样,才能使政府、企业、和高校之间形成一种有效、长期、稳定的和谐关系,从而保证政产学研

研合作共同利益导向性,推动合作长久地进行下去。

### 3. 强化管理协调是高校政产学研合作持续发展的动力之源

高校政产学研合作既是目标统一、各方收益的过程,更是分工明确、责权分明的结果,这就需要主体各方在合作过程中强化管理、注重协调,重视管理协调对合作的驱动作用,建立科学高效的管理模式和协调机制,在管理协调中找准合作的切入点和利益的结合点,从而为政产学研合作的高效开展和可持续发展提供动力。

### 参考文献:

- [1] 石丽敏. 国外校企合作办学模式的分析与研究[J]. 高等农业教育, 2006 (12).
- [2] 杨 琰. 产学研合作教育的内涵及现实意义探析[J]. 肇庆学院学报, 2008(11).
- [3] 高 兵. 政产学研合作促进学科建设的实践与探索[J]. 教育探索, 2009(12).
- [4] 潘懋元. 产学研合作教育的几个理论问题[J]. 中国大学教学, 2008(3).

## Promoting Development of Government Production and Research by Building an Effective Interactive Platform between Universities and Enterprises

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**Abstract:** The combination of government, production, and research is an effective form for development of mutually-beneficial and win-win cooperative education between universities, government, and industry, which is of great significance for promoting the directing function of personnel training, the conversion of scientific achievements and the industrialization of higher education, and also promotes all-round cooperation and deep integration between universities and industry. This paper makes an empirical analysis of government production and research cooperation which is under the management of board of Civil Aviation, Nanjing University of Aeronautics and Astronautics, outlines the meaning and necessity of government production and research, and proposes basic ideas for universities to carry out the cooperation among government, production, and research.

**Key words:** interaction between universities and enterprises; government production learning research; cooperation

# 新挑战

经济国际谈判和国际规则制定。中国要作为重要的一方参与制定低碳经济运行规则,既要承担作为负责任的发展中大国的历史责任,又不能让低碳经济变成发达国家

经济的筹码,积极影响新的经济秩序朝着公平方向发展。同时积极鼓励和扶持企业参与新一轮标准的制订,包括行业能耗标准、行业碳排放标准、低碳产品和技术认定等,为国内企业转型争取主

着手构建低碳经济税制体系。要建立起一套以碳税等组成的低碳经济税制体系。一方面,碳税是符合规则的,但双重征税是违反WTO原则的,开征碳税想征收的税费由国内征收,税收资金可以用于生态环境保护和减排。另一方面,低碳经济税制体系国内产业结构调整 and 经济发展方式转变,有利于的改善。并且,通过税收结构调整,在征收碳税等可以降低企业所得税等其他税收负担,这样企业的有提高,但加大了减排力度。

加快建立碳金融体系。要借鉴国际经验,加强碳合作,加快支持低碳经济发展的碳金融衍生工具,包括碳掉期交易、碳证券、碳期货、碳基金等,改变全球碳市场价值链中的低端位置。同时,要抓住努力促使人民币与碳排放权绑定,推进碳交易价格的国际化进程,提升人民币在国际货币体系中

着力提升低碳技术自主创新能力。国家要抓住自主创新核心,加大低碳技术研发投入和支持力度,设立基金,加强产学研合作,集中优势科技力量,站在国际前沿,统一制定技术攻关计划,支持培育重大自主创新应用,力争在低碳领域核心技术和尖端工艺等领先优势。

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# 完善

立法的过程中,特别是在立法听证和辩论阶段,要让广大公众参与进来,就行使知情权的有关问题发表意见,使不同的观点和利益诉求有充分交流、交锋的机会。就信息公开的范围而言,立法者如果

能够吸收行政主体以外的意见和建议,从实现和保障知情权出发,站在“权利主体”的立场加以考量,就应该对不公开信息范围进行严格的限制。由此,适当地对行政需求和权力诉求加以平衡,从而不断完善立法。

第二,发挥民间组织的作用,推动信息公开制度的建立和完善。国外的历史表明,信息公开的一支重要推动力量就是民间组织。与个体方式相比,以社团方式申请信息公开,无疑更能促使政府部门积极履行信息公开义

自1993年创办以来,南京航空航天大学民航学院坚持“立足民航,依靠民航,服务民航”的开放办学型思路,积极争取民航总局、民航企业的支持与合作,建立和实施了董事会管理体制,走出了一条政产学研合作办学的新路子。

## 实施董事会管理体制,搭建政产学研合作的有效组织管理平台

政产学研结合,是指政府、企业、高等院校或科研院所等主体要素为了共同的目标和利益,充分发挥各方优势而形成的互惠多赢的合作关系。政产学研结合是市场经济与知识经济相结合的必然产物,也是国家创新体系的重要组成部分。20世纪90

年代,南京航空航天大学作为一所具有国防科技特色的中央部属重点大学,面对中国民航事业大发展的机遇,学校整合相关学科专业的办学资源,充分发挥已有的人才和智力优势,积极争取上级主管部门和民航企事业单位的支持,拓展服务面向高起点,跻身民航科教事业。1993年,中国民航总局和中国航空工业总公司正式联合创办南京航空航天大学民航学院。

为了充分发挥民航管理部门、民航企事业单位和我校的协同效应,1994年5月,在中国民航总局的指导下,成立了以民航骨干企业和南京航空航天大学为主体的南京航空航天大学民航学院董事会,制定了董事会章程,明确了企业和学校的权利与义务,规范了合作机制、校企联合办学的运作方式。章程规定,董事会是对南航大民航学院建设和发展中的重要事务进行决策、咨询、评议、审议和指导的机构,主要职责包括:对办学目标、办学方向、办学规模等战略发展定位进行审议、指导和决策;对学院的学科与专业建设、招生与就业、科学研究、科技开发、管理和改革、基础设施建设等重大事项提供决策咨询和监督指导;根据民航事业发展对人才的需求,结合董事单位的人才需求标准,审

司、机场对人才培养的意见和建议,为建立符合民航人才需求特点的培养方案奠定了坚实基础。董事会积极收集各董事单位对人才的需求,理性分析人才需求的变化,深入研办学资源、办学形状,细化专业培养目标。在“交通运输”专业内,细化了交通运输管理、机务工程、民航电子电气工程、空中交通管理与签派等专业方向,积极开展“适航管理”等辅修和第二专业修读;为满足民航事业发展对飞行、空管、机务人才的特殊需求,采用“2+2、3+1”等分流培养模式;为满足行业对高层次人才需求,依托自身人才培养优势,面向民航企事业单位开展了工程硕士班、博士班、在职培训等。

## 发挥董事会的体制优势,推进校企全方位深度合作

以我国民航排头兵企业为主体的南京航空航天大学民航学院董事会,是建立和发展学校与民航企事业单位全方位深度合作的桥梁和纽带。在董事会合作模式下,各董事单位对民航学院的成长和壮大倾注了满腔热情,给予了大力支持。据统计,从1994年至2009年的16年间,各董事单位直接投资我校民航教育的经费,到款总额达4000余万元,捐赠航材价值1500余万元,学校先后建成了“空管雷达模拟实验室”、“程序管制模拟实验室”、“民航发动机故障诊断实验室”、“机务CBT实验室”、“飞行数据和译码实验室”和“民航管理信息系统实验室”。此外,学校积极与各董事单位开展双向人才交流,选拔了一批优秀中青年骨干教师到民航企业一线开展科研合作和挂职锻炼,参与企业组团赴先进国家学习和考察,促进了专业教师的迅速成长。

加强学科建设是民航学院在更高层次为企业提供人才服务的客观需要。学校抓住民航教育要向高层次发展的机遇,整合资源,大力加强民航类学科专业建设,建成了民航系统内唯一的一个一级学科“交通运输工程”博士学位授权点和博士后流动站,同时建立了交

# 政产学研合作模式的新探索

阎雷 刘建成

力的民间组织、律师协、工商联等。应明确民间组织“利益表达”的职责,继续发挥好这些组织为不同利益群体“代言”的作用,鼓励其积极行使知情权,参与公共事务,从而使政府和民间组织之间的对话与交流经常化。在此基础上,信息公开才能获得更大的推动力。

第三,发挥新闻媒体的作用,强化信息公开的舆论监督。新闻媒体是公共信息的主要发布渠道,可以通过新闻采访、新闻调查、新闻访谈等获取政府信息,还可以成为公民公开讨论问题的平台,由此实现对信息公开的监督,在推进信息公开方面发挥重要作用。当前,一方面要采取各种措施保障记者的采访权,另一方面要鼓励公民通过各种新闻媒体进行公共讨论、发表意见看法,使新闻媒体成为构建和完善信息公开制度的重要组成部分。

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案;本着互惠互利的原则,联络和督办合作教育培养事宜,促进和开展校企双方的人才培养、在职进修、培训以及学历教育;积极推动和促进与董事单位的科技交流合作、科研项目研究以及科研成果开发、转化和应用。

### 主动面向民航发展的人才需求,全面优化育人模式

立足民航发展对高素质人才的现实需求,坚持校企协调互动,推进人才培养模式改革与创新,增强人才培养的针对性和有效性,是民航事业发展的最重要的课题。为此,学校组织专家、学者反复深入民航企业调研,详细了解单位用人需求。组织召开“民航人才需求特点与培养模式研讨会”,充分听取民航总局领导和国内各大航空公

输规划与管理等四个二级学科博士点、五个硕士点、三个专业硕士学位授权点及七个本科专业及方向,成立了航空安全与保障技术研究所、空中交通管理研究所、交通信息工程研究所、民航软科学研究所,以及一个民航总局重点科研基地——民航机务维修工程科研基地,形成了能够满足民航行业主要方向的学科专业体系和人才培养体系。此外,为满足行业对高层次人才的迫切需要,学校还依托自身优势,面向民航第二研究所、民航局安全技术中心等董事会单位,开展了工程硕士班、博士班、在职培训等服务。正是在学校的教育改革实践中,逐步形成了学校积极面向企业提供服务、企业热情支持学校培养人才的双向互动的良好局面。

(作者单位:南京航空航天大学)

强环保法律、政策和技术咨询服务;人大代表、政协委员通过执法检查等手段,不断强化环境质量监督;全市设立了生态建设中心和公众举报电话,实行有奖举报制度,市民对生态环境的知情权、参与权和监督权不断扩大。所有这些,都为厦门生态文明建设提供了不可或缺的制度机制保证。

以崇尚和谐理念的和谐文化,鼓励一切有助于促进和谐的言行,不断增加社会生活中的和谐因素,建立健全保障社会的各种法律的、制度的、道德的规范体系,使社会既充满活力又团结和谐。特区建设以来,厦门坚持节约发展、清洁发展、安

93.89%;重点工业企业二氧化硫达标排放率 100%;全市重点工业固体废物综合利用率 91.2%,医疗垃圾和化学危险废物处置率 100%。 $SO_2$  和 COD 排放总量分别为 4.67 万吨和 4.70 万吨,较上年削减 11.95%和 5.82%。2009 年,厦门新增城市绿地 700 公顷、生态风景林建设 1.2 万亩,实施成功大道、环岛干道、仙岳路等主干道景观综合整治,完成 58 万平方米沙滩修复整治。强化机动车尾气、扬尘、工业废气等污染控制,空气质量优良率比 2008 年上升近两个百分点。所有这些,无不显示厦门在生态文明建设方面所取得的实实在在的成效。

### 生态文明促进厦门确立人与人和谐相处的价值取向

优美的生态环境不仅给厦门人民提供了良好的居住环境,

更促进了人与人之间的和谐相处,大大提高了广大市民的文明素养。如今几乎每一个生活在这座城市的人,都非常珍惜厦门的自然生态环境,并形成了自觉维护城市良好形象的意识,这种自觉意识反过来又促进厦门和谐文化思想的进一步提升。这是厦门生态文明建设特别值得珍惜的宝贵经验。在过去的两次评

# 态文明的重要支撑

为代价,相反,在生态文明建设方面取得了很大的成就,较好地解决了经济增长与生态保护、物质积累与社会文化繁荣、短期与可持续发展的矛盾。近年来,厦门在大力促进经济社会发展的同时,更加注重生态保护。2005 年,厦门每立方米工业实现工业产值 2603 元,每平方公里土地创造生产总值 6562 元,创造工业总产值 1.34 亿元,每千瓦时工业用电实现工业产值 61 元,均居全省最高水平。2006 年,厦门全年环保投入约 10 亿元,占生产总值的 2.4%。在节能降耗方面,2006 年厦门万元生产总值耗电 888.1 千瓦时,比上年减少 5.7 千瓦时;万元生产总值耗水 19.5 吨,比上年减少 1.3 吨,这些指标均保持全国领先发达国家水平。其中万元生产总值综合能耗约 0.63 吨标煤,约为全国平均水平的一半。截至 2006 年年末,全市已有 100 多家企业通过 ISO14001 环境管理体系认证,不少企业还纷纷采用生态型工业及循环经济发展模式,并初步建立了环境污染突发环境事件应急预案体系。2007 年,厦门万元生产总值综合能耗和主要污染物排放量继续下降,其中万元生产总值耗电量 802.01 千瓦时,比上年下降 19.4 度,万元生产总值耗水 18 吨,下降 6.2 吨。2008 年,厦门全市万元生产总值(GDP)耗电 802.01 千瓦时,比上年减少 54.56 千瓦时,万元生产总值(GDP)耗水 16.3 吨,比上年减少 1.6 吨,城市环境空气质量优良率为 96.7%,优良率 33.3%;区域环境噪声平均值为 56.0 分贝,交通干线噪声平均值为 68.4 分贝,集中式饮用水水质达标率 100%。全市重点工业废水达标排放率 100%,重点工业用水重复利用率

比中,厦门都以总分第一夺得全国文明城市荣誉称号。这足以说明厦门的“文明”建设所取得的成就是举国公认的。

近年来,厦门十分注重生态环境宣传教育工作,始终坚持以弘扬生态文明为着眼点,以推动公众参与为抓手,以绿色创建为突破口,环保、宣传、教育、新闻等部门在生态文明创建方面密切合作、形成合力,大力开展生态道德的全民教育,提高全体公民、特别是广大青少年的生态道德素质。他们还通过“小手牵大手”活动,带动了家庭、辐射了社区、推动了全民广泛地参与保护环境的行动。这些举措不仅产生了明显的社会生态文明建设效益,更产生了良好的和谐社会建设效益。此外,厦门市还充分发挥和挖掘环保民间组织的作用,形成政府引导、公众参与环境保护的良性发展局面。目前厦门市共有民间环保组织 13 个。他们组织环保宣传、监督环境执法、提出政策建议、维护公民环境权益,成为厦门环境保护的一支重要力量。由民间组织发起的“鹭岛关爱日”活动,倡导“绿色生活行动、让环保进入我们的生活”理念,动员市民用实际行动建设和美化大家共同的家园,已成为厦门市市民热衷参与、关爱环境的一个重要节日。正是因为努力建立和发展以和谐为核心的价值体系,在全社会形成以尊重和实现和谐为荣、以背离和破坏和谐为耻的价值取向,并使和谐社会的思想道德要求内化和深化为群众的思想和行为,和日常生活理性,正是因为通过生态文明建设,厦门人在改变人与自然关系的同时,也改变着人与人之间的关系。

(作者系福建省厦门市社科院副院长)

## Work-value motivation policy design based on neural networks for public scientific research institutions\*

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**Abstract** — Since public scientific research institutions (PSRI) are the important component and primary providers of public knowledge goods in national scientific and technological system, and the management for these institutions should be adapted to the self-realization demands, work value and material motivation needs of their personnel, motivation policy design was studied. Important meaning of motivation policies for PSRIs to increase their performance, enhance the personnel satisfactory degree as well to realize the value consistency between organizations and personnel, was also studied in detail. Since motivation policy system for PSRIs is a multi-objective optimization system, and various incentive factors have indirect effects on PSRI operations, motivation policy design for PSRI was studied as a nonlinear optimization problem. According to the characteristics of nonlinear multi-objective optimization problems, a model using neural network method was brought forward to design motivation policies for PSRIs. Quantitative policies were obtained by the motivation model. Examples from a scientific research institute demonstrated that the method is effective.

**Keywords:** work value, motivation policy, neural networks, nonlinear multi-objective optimization

### 1 Introduction

Public scientific research institutions (PSRI) are the important component of the national innovative system and main providers of public scientific services for the society. It is an issue that all states pay a lot of attention to improve the organizational efficiency of PSRIs, to fully play their roles and increase their creativeness. To motivate employees scientifically is an important way to improve the operational efficiency of PSRIs.

The motive effects to employees of PSRIs are influenced by 3 factors. The first comes from the characters of the employees themselves. Employees of PSRIs are mainly composed of intellectuals, who are highly independent, have stronger sense of self-value and clearer target, and have higher expectation for the challenges and creativeness of their work, for the satisfaction to their work, for their working environment, for the personal development space provided by their work as well as the human-cultural concern within their organizations. The second comes from the characters of their work, most of which is innovative work accomplished in forms of team-work. Therefore, the co-operation of employees has direct influences on the efficiency of PSRIs. The third comes from the characters of their organization. PSRIs have some distinct characters. For example, their goals are not for profit, their tasks are strategic and critical, their achievements are for public use and have highly over-flowing benefits, their performances are not for markets, their internal research actions are relatively open

to the outside society, and various resources input for them have higher risk. Because of all the above, it is very difficult for PSRIs to embody their achievements into economic profits. These require the employees working in PSRIs have higher sense of social responsibilities and contributions. Because of the interaction among the 3 factors, motivation for employees of PSRIs is highly complex. In theory, a successful motivation scheme should be able to make employees play their specialties and potentials fully and consciously. From this point of view, motivation mechanism should change from pure management of human behavior onto deeper level management of personnel value. Motivation based on work value is in accordance with internal-agreement, an important theory of current human resources management. Therefore, it is able to avoid role confusions and profit conflicts among employees that are caused by non-matches between organization value and the values of its employees and make them behave in accordance with the benefit of their organization (Shuler and Jackson, 1988 [6]). One possible path that work value influences personnel work behavior and performance is as follows:

work value → work motivation → work performance.

This paper dealt with work value motivation problem for employees in PSRIs, including motivation forms, modes and effects. Based on the analysis on work value structure of PSRI employees, motivation schemes for PSRIs were discussed. Since traditional researches on work value motivation are confined in qualitative areas, their applications into practice and their scientific natures are restrained in a degree. Considering the complexity of work performance influences by work value motivation, the uncertainty between behaviors and work results, the difficulty to qualify motivation effects and recognize their quality, the co-existence of longer and shorter term influences, the diversity of employees motivated, the difficulty to dissolve team work products, etc, neural network method was introduced into the design of employee motivation scheme for PSRIs. Questionnaires were used as the input for neural network model, and the composite valuation of personnel performance as its output. By training and testing the neural network, extracting motive factors, motivation effects of different motivation schemes for different employees were analyzed. By setting up a personnel motivation model based on neural network and simulating the results of motivation schemes, it is realized to provide decision-making support with quantitative motivation schemes for PSRIs.

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## 2 Personnel motivation based on work value for PSRIs

### 2.1 Definition and features of work value

View-point of value, or value for short, is a kind of permanent believes, which means that an individual or society prefers a specific behavior mode or objective state to other ones, and has the functions to guide individual behaviors, help the individual to make decisions, solve confictions and motivate the individual to attain his/her self-realization. As an important component within the whole value of an individual, work value is the value judgment of the individual about his/her work behavior and the result obtained from his/her work environment (Dose, 1997 [1]), is an internal thinking system directly influencing his/her behaviors (Elizur, 1984 [2]), including a series of concepts from professional ethic morality, work preference (Pryor, 1998 [5]) and work demands (Super, 1980 [7]). In spite of the differences among intensions and extensions of definitions given by scholars at home and aboard, generally speaking, work value has the features as follow: (1) It is what a person want to get from his/her work; (2) It reflects relations between needs and satisfactory; (3) It reflects the selection of preference and is not a moral force; (4) It reflects the preference that a person behave in a specific way but not other one; (5) It is an internal motive to guide the direction and motion of a person's behavior and to make him/her move towards his/her target of life; (6) It is an inner yardstick for a person to measure the advantage, meaning and importance of his/her social profession, a valuation on his/her social profession, a reflection of value of life onto his/her view of profession, a belief and attitude of a person toward his/her work.

In the deepening progress of researches on work value, it has been shown by scholars at different levels and in different dimensions that whether the work values of employees are in accordance with their work features and the value of their organization is a critical factor to determine their work efficiency.

### 2.2 Motivation of Work Value

Researches by Locke & Henne have shown that work value of a person will influence his/her work desire or target, and further, influence his/her work behavior and the degree of endeavor (Locke and Henne, 1986 [4]). Therefore, work performance of a person or an organization can be improved significantly by analyzing the attributes and functions of work value, fostering rational work value among members of the organization, and realizing the value consistency between individuals and the organization. Nevertheless, attributes of individual values shows that values within an organization are possibly different. It is even possibly out of different value when members within a same organization are pursuing a same objective effect. For example, it is possible for some persons to show their competence, some to be responsible for their work, some to seek social agreement, some others to get more rewards, etc. It is quite often in management practices that there are significant differences of individual values hidden behind a same phenomenon. With this in mind, it is necessary to implement scientific value management, i.e., to introduce a motivation mechanism, set up a mechanism of behavior guidance and morality cost compensation with the core of reward and penalty, make a correct work value to be the common behavior mode of all members in the organization, allow them to share the benefits of the new order, and meanwhile, push the persons who refuse the organizational value into "frontier".

### 2.3 Function analysis on motivation based on work value

Following functions can be realized by a motivation of work value:

First, increase member commitment to their organization. It is possible that by a motivation of work value, members are promoted to consider continuously the development of their organization as well as themselves, to adjust their behavior continuously in a dynamic environment in order to keep good relationship with their organization, to link their personal career development closely together with the development of their organization, and in the end, to increase their commitment to the organization.

Second, increase work endeavor. Work value is an important factor to influence personal endeavor. Many scholars found that there is correlativeness between work value and work endeavor, such as that work endeavor of employees are rather correlative positively to the values of achievement development, altruism, challenge, inter-personal relation but not relative significantly to the value of material rewards. Although the current classifications are not similar to each other, it can be found that work value as a whole is positively and significantly correlative to work endeavor, i.e., the more positive is the work value, the greater the work endeavor of employees will be.

Third, increase work efficiency. It is possible that by value motivation, members in an organization can develop their independent activeness, avoid communication barriers and decreases of work efficiency owing to "dissymmetry of information" among them, and in the end, increase their work efficiency.

## 3 Personnel motivation model based on neural network for PSRIs

### 3.1 Neural network

Neural network is an algorithm for data mining which makes computers to behave with an intelligent feature. It tries to simulate the functions of human and animals, realize the procedures of mode recognition and mechanic learning algorithm, and set up predict models by calculating a large amount of historical data. On the base of training and learning, a neural network system can set up models rapidly for a large amount of non-linear data and make simulation recognition without human intervention in order to solve problems in a specific area. In neural networks, variables are called neural elements. The analytical process is to put one or more neural elements at input layer as determinants, put other one or more neural elements at output layer as dependents, and then determine the weights of neural elements at hidden layer by learning and inducting a part of training cases. In this way, projective relations can be set up among neural elements at input and output layers in order to predict and interpret the dependents. Neural network analysis allows higher elasticity for data collected, so it overcomes many obstacles in traditional multiple regressive statistical analysis. By suitable training and learning, relations among determinants and dependents can be inducted and objective analytical results obtained.

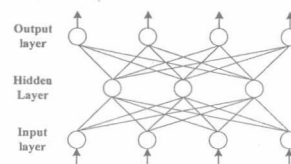


Fig. 1 Neural network structure

A neural network is composed of input, output and hidden layers, as shown in Fig. 1. There may be one or more hidden layers in a neural network, with multiple elements at each layer. It has the features that neural elements at each layer are connected only to elements at neighboring layers but there is none connection among elements within a same layer. And there is none feedback connection among neural elements at different layers. Input signals are first transmitted forward to hidden knots. After passing through transforming functions, output information out of hidden knots is transmitted to output knots and results are obtained after processing. Sigmoid functions are usually chosen as transforming functions at knots.

If there are  $n$  neural elements at input layer and  $m$  elements at output layer, the network will be a projection from an  $n$  dimensional Euclidean space to an  $m$  dimensional one. While the structure of a neural network is determined, the network can realize given projective relations for inputs and outputs and approximate any non-linear function at any precision. Neural networks are suitable to express complex physical or social phenomenon and may solve many practical problems. After training and learning, neural networks can provide suitable output even for inputs not in sample sets. Therefore, it is feasible in this paper to research personnel motivation scheme for PSRIs.

### 3.2 Model-setting process based on neural network for personnel motivation in PSRIs

It is composed of the following key steps to set up a personnel motivation model, as shown in Fig. 2.

- (1) Data acquisition. Collect factors influencing work value of personnel in PSRIs, which can generally be obtained in the form of questionnaires. Collect data related to comprehensive performance of the personnel, which include not only the current personnel

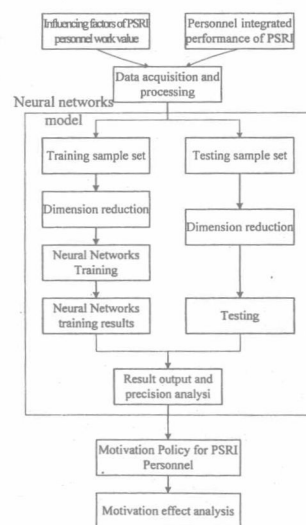


Fig. 2 Neural network structure

performance but also the relative result indexes embodying work value motivation, such as work satisfactory, organization commitment, etc. Collections of data are corresponding to the input and output of neural network respectively.

- (2) Set up a model of personnel motivation based on neural network for PSRIs. Divide the obtained data into training sample and

testing one, with the former to obtain the structure of neural network, and the latter to verify the performance and effectiveness of the network.

- (3) Design personnel motivation schemes of work value for PSRIs. While using the trained neural network, analyze key factors among the current work value factors that influence work performance of employees, and use them as motivation factors to determine the motivation intensity.

- (4) Simulate the result of motivation schemes. Input motivation schemes into the trained neural network, and verify the result of the schemes for different individuals in order to provide auxiliary decision-making support for designing an individualized motivation scheme.

### 3.3 Algorithm steps

Algorithm steps to design personnel motivation schemes for PSRIs by use of neural network are as follows:

- (1) Design network structure. Numbers of input and output knots are determined by the problem in consideration. Number of hidden knots is determined according to the convergence and can be determined with trial calculations or experienced formulas. A general formula is

$$s = \sqrt{0.43nm + 0.12n^2 + 2.54n + 0.77m + 0.35 + 0.51}.$$

- (2) Use random numbers (generally between 0 and 1) to initialize  $\omega_{ij}$  and  $\theta_{ij}$ , herein  $\omega_{ij}$  is the connective weight of neural element  $j$ , and  $\theta_j$  is the threshold value of neural element  $j$  at hidden or output layer.

- (3) Pre-process the training sample set  $x_{pl}$  and the correspondent expected output  $y_{pl}$ . Herein  $p$  and  $l$  mean numbers of elements within the sample and of input vectors respectively.

- (4) Calculate output  $O$  for each layer. For input layer, output is the same with input, that is,  $O_{pi} = x_{pi}$ , herein  $x_{pi}$  is the  $i$ th value of the  $p$ th sample element. And for hidden and output layers, the output operations to neural elements are

$$O_{pj} = f \left( \sum_i \omega_{ji} O_{pi} - \theta_j \right),$$

herein  $O_{pi}$  is the output of element  $i$  as well as the input of element  $j$ ,  $f(x)$  is a non-linear non-reductive differentiable function, which generally takes the form of  $S$ .

- (5) Calculate error signals at each layer.

$$\delta_{pj} = (y_{pj} - O_{pj}) O_{pj} (1 - O_{pj})$$

at output level; and

$$\delta_{pj} = O_{pj} (1 - O_{pj}) \sum_j \delta_{pj} \omega_{pj}$$

at hidden layer.

- (6) Transmit backward in order to adjust the weights

$$\omega_{ij}(t+1) = \omega_{ij}(t) + \alpha \delta_{ij} O_{pj},$$

herein  $\alpha$  means the learning speed.

- (7) Calculate the error.

$$E_r = \frac{1}{2} \sum_p \sum_k (O_{pk} - y_{pk})^2,$$

if the training process for network is ended, otherwise, go back to step iv and continue with the training process.

- (8) Verify the effectiveness and precision of the trained sample by using the test sample.

## 4 Analysis on calculation case

### 4.1 Data acquisition and processing

- (1) Questionnaires for personnel work values in PSRIs.

Questionnaire for PSRIs was designed in order to collect factors related to work values of personnel in PSRIs. As shown in Tab.

Table 1 Questionnaire of operational efficiency and benefit factors for PSRIs

Index	Factor	Index	Factor
C <sub>1</sub>	Consciousness of national development strategy	C <sub>28</sub>	Reasonable mechanism for achievement sharing and transfer
C <sub>2</sub>	National level of science and technology development	C <sub>29</sub>	Perfect <b>personnel training</b> mechanism
C <sub>3</sub>	National system and total amount of economy development	C <sub>30</sub>	Performance appraisal system leading personnel to key and strategic research fields
C <sub>4</sub>	Position of the institution and legal assurance	C <sub>31</sub>	Performance appraisal system leading personnel to concern
C <sub>5</sub>	Relevant policies and implementation	C <sub>32</sub>	Appraisal system for higher research performance
C <sub>6</sub>	Basic conditions and funds income	C <sub>33</sub>	Salary system encouraging competitions
C <sub>7</sub>	Bright development prospects	C <sub>34</sub>	Consummate and reasonable promotion mechanism for management staffs
C <sub>8</sub>	Position in national construction	C <sub>35</sub>	Consummate and reasonable evaluation mechanism for professional titles
C <sub>9</sub>	Development plan and objectives	C <sub>36</sub>	Rational and orderly exchange mechanism for talented staffs
C <sub>10</sub>	Reputable academic leaders	C <sub>37</sub>	Good relationship between leaders and personnel
C <sub>11</sub>	Satisfactory work facilities	C <sub>38</sub>	Atmosphere of union and co-operation among personnel
C <sub>12</sub>	Advocating conventions and inheritance	C <sub>39</sub>	Reasonable post setting
C <sub>13</sub>	Encourage to pay attention to virtue and be indifferent to fame and gains	C <sub>40</sub>	Clear understanding of post responsibility and duty
C <sub>14</sub>	Encourage to pursue individual interests	C <sub>41</sub>	Jobs in accordance with career plan
C <sub>15</sub>	Encourage academic freedom	C <sub>42</sub>	Aesthetic feeling from work
C <sub>16</sub>	Generous environment of allowing failures	C <sub>43</sub>	Jobs in accordance with personal interests
C <sub>17</sub>	Advocate fair competitions and equal opportunities	C <sub>44</sub>	Jobs inspiring creativity
C <sub>18</sub>	Advocate an organization atmosphere of the Golden Mean	C <sub>45</sub>	Job Challenge
C <sub>19</sub>	<b>Balance and coordination</b> of life and work	C <sub>46</sub>	Jobs improving quality and developing ability
C <sub>20</sub>	Atmosphere and system guarantee for talented persons	C <sub>47</sub>	<b>Jobs with more autonomy</b>
C <sub>21</sub>	Centralized organization structure with clear levels	C <sub>48</sub>	Achievement feeling from work
C <sub>22</sub>	Decentralized flat organization structure	C <sub>49</sub>	Adequate respects from work
C <sub>23</sub>	Decision mechanism with broad participation of staffs	C <sub>50</sub>	Satisfactory salary and welfare
C <sub>24</sub>	Research projects established according to organization objectives	C <sub>51</sub>	Job Stability
C <sub>25</sub>	Effective management of research projects	C <sub>52</sub>	Relaxing body and mind
C <sub>26</sub>	Reasonable scientific research achievement evaluation mechanism	C <sub>53</sub>	Traffic convenience
C <sub>27</sub>	Advocate to team study		

Table 2 Matrix of rotated load factors and their contributions

Factor	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	F <sub>6</sub>	F <sub>7</sub>	F <sub>8</sub>
Eigenvalue	7.339	6.899	6.436	3.976	3.116	2.509	2.266	1.797
Contribution	14.98%	14.08%	13.13%	8.11%	6.36%	5.12%	4.62%	3.67%
Accumulated value	14.98%	29.06%	42.19%	50.30%	56.66%	61.78%	66.40%	70.07%

1, it contains 53 items including external environment and internal operational mechanism of the organization, self-development of personnel, material and spiritual rewards and so on (Feng and Li, 2009 [3]). 5-point remark was used for the questionnaire with Fig. 1 and Fig. 2 to mean 5 levels from "the least important" to "the most important". Questionnaires were distributed and collected in a lumped way, with 362 questionnaires distributed and 292 effective ones collected.

(2) Data Acquisition and Processing for Comprehensive Personnel Performance Based on Work Value Motivation.

Motivational function of work value can be an increase of current work performance or a nonconscious influence onto the personnel, and the latter cannot be measured with the current performance. With this in mind, the following indexes were used to measure the motivational effect of work value by the means of weighted sum. Main indexes selected are as following: Current Personnel Performance, personnel satisfactory, personnel commitment, consistency of the targets of personnel and the organization and long term development of personnel.

Among them, the first index mainly used the result of year-end appraisal, indexes from 2 to 4 were obtained by means of questionnaires, and index 5 was according to the comprehensive points from personnel department and the department leaders of relevant employees. Data space is [0, 1], herein 0 means the worst and 1 means the best. Weights for the indexes were determined with in-

formation from specialist, among which, weight for index 1 is 0.5, and 0.2 for index 2, 0.1 for index 3 ~ 5.

Table 3 Influences onto personnel comprehensive performance by their work value

Factor	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	F <sub>6</sub>	F <sub>7</sub>	F <sub>8</sub>
Mean value	5.12	0.72	3.71	8.56	7.25	4.56	-0.28	0.11

#### 4.2 Structural design, training and test result of neural network

(1) Dimension reduction for data.

Factor analysis was made for original data in order to reduce data dimension, avoid data intercross and overlap, and reduce the difficulty to train the neural network. Statistical analysis was made with the software of SPSS13.0. And 8 factors were selected with the criteria that their information amount is more than 70%. Rotated load factors and their contributions are shown in Tab. 2.

(2) Structural design of neural network.

With the above initial processing, original data were reduced to 8 factors, which were input knots of the network. There was only 1 output knot, that is, comprehensive judgment of employees. Number of hidden knots were approximately determined as 4 with trial calculation formula. Therefore, structure of the network is 8 → 4 → 1.

(3) Training and testing result of the neural network.

Table 4 Predicted results for motivation policies of work value

Sample	Score	Origin IPS	Scheme 1		Scheme 2		Scheme 3		Scheme 1 and 2		Scheme 1 and 3		Scheme 2 and 3		All Schemes	
			IPS	Se	IPS	Se	IPS	Se	IPS	Se	IPS	Se	IPS	Se	IPS	Se
Sample 1	0.75	0.765	2.00	0.781	4.13	0.750	0.00	0.840	12.00	0.770	2.67	0.781	4.13	0.840	12.00	
Sample 2	0.67	0.681	1.64	0.721	7.61	0.752	12.31	0.768	14.63	0.799	19.40	0.828	23.58	0.857	27.91	
Sample 3	0.72	0.734	1.94	0.765	6.25	0.801	11.25	0.790	9.72	0.821	13.89	0.854	18.61	0.882	22.50	
Sample 4	0.95	0.951	0.11	0.962	1.26	0.950	0.00	0.96	1.05	0.950	0.00	0.962	1.26	0.96	1.05	
Sample 5	0.81	0.850	4.94	0.842	3.95	0.810	0.00	0.921	13.70	0.850	4.94	0.842	3.95	0.921	13.70	
Sample 6	0.65	0.660	1.54	0.691	6.31	0.650	0.00	0.715	10.00	0.661	1.54	0.691	6.31	0.715	10.00	
Sample 7	0.91	0.930	2.20	0.946	0.96	0.899	−1.11	0.935	2.75	0.921	1.10	0.907	−0.33	0.924	1.54	
Sample 8	0.78	0.820	5.13	0.812	4.10	0.785	0.64	0.921	18.08	0.829	6.41	0.875	12.17	0.925	18.59	
Sample 9	0.83	0.850	2.41	0.863	3.98	0.832	0.24	0.905	9.04	0.851	2.41	0.881	6.14	0.908	9.40	
Sample 10	0.88	0.899	2.27	0.920	4.55	0.880	0.00	0.931	5.80	0.899	0.00	0.920	4.55	0.931	5.80	

Among the 292 questionnaires, 200 were randomly chosen as training sample, and the other 92 as testing sample. For this paper, Matlab software was chosen to make training and simulation with the relevant data. By simulation, degrees of influences onto personnel comprehensive performance by their work value were obtained as shown in Tab. 3.

Compared with the testing sample, average error rate of the result of the neural network was than 10%, which shows that the trained sample basically meet our requirements.

#### 4.3 Design of personnel motivation scheme of work value for PSRIs

8 factors were extracted on the base of factor analysis for original data. Meaning of the 8 factors is as follows:

$F_1$  means the influence of project operations on personnel work value of PSRIs,

$F_2$  means the influence of outside elements,

$F_3$  means the influence of personal growth and value realization,

$F_4$  means the influence of internal environment,

$F_5$  means the influence of material and spiritual rewards,

$F_6$  means the influence of performance

$F_7$  means the influence of environmental elements such as health and communications,

$F_8$  means the influence of work style of leaders.

With the current sample data, it was determined that important degrees of work value onto different structures were as follows:  $F_4$ ,  $F_5$ ,  $F_6$ ,  $F_1$ ,  $F_3$ ,  $F_2$ ,  $F_8$  and  $F_7$ . We determined that main motivation policies for employees could include the following: a. to raise personnel income, b. to improve internal mode and regulations for project management, and c. to strengthen exceptional promotion mechanism.

#### 4.4 Simulation result of the motivation schemes for different samples

3 personnel motivation schemes of work value designed for PSRIs in 4.3 were called scheme 1, 2 and 3 respectively. Simulation took the form of composite verification, including to use scheme 1, 2 and 3 independently, to use them 2 by 2 as a group, and to use all the 3 together. Motivation strength was 10% increase on the base of original motivation schemes. 10 samples were randomly extracted. Their responses to the motivation schemes were determined with the methods of specialist information and inference. Input for neural network was adjusted to predict the comprehensive performance. Predicted motivation effects by the neural network were as shown in Tab. 4. Herein IPS means the comprehensive personnel performance, and Se means the sensitiveness of the schemes, which was expressed by percentage increased.

Following conclusions can be obtained from the current training results:

(1) In general, responses of different sample element to the schemes were somehow different. Therefore, differentiated motivation schemes should be adopted in PSRIs in order to improve the motivation effects significantly.

(2) Current comprehensive performance was higher than individual one. This meant that whole motivation effect were not significant, perfect work value were nearly set up, individual objectives were basically in accordance with organizational one, and higher work efficiency and performance were well obtained.

(3) There were some individuals who had lower performance. This showed that there values were far deviated from the organizational value. They should be guided to set up a work value in accordance with the organizational target, by improving management and increase their material and spiritual rewards.

(4) The policy of exceptional promotion was significantly effective for only a few employees but not so effective for most of the others. Even worse, this could have negative effects on some individuals within the organization, which should be paid more attention when such a scheme of work value motivation was adopted.

#### 5 Summary

In this paper, the feasibility and effects of motivation based on work value were discussed in combination with the function features of PSRIs and self-realization demands of their personnel. Motivation model of personnel work value in PSRIs based on neural network was set up. On the base of training result of neural network, motivation schemes of personnel work value was designed. Results of personnel performance increase for different motivation schemes were predicted by simulation analysis for neural network. Effectiveness of the method put forward in this paper was verified with practical examples.

#### References

- [1] Dose, J. (1997) Work values: an integrative framework and illustrative application to organizational socialization. *Journal of Occupational Organizational Psychology*, 3:219-242.
- [2] Elizur, D. (1984) Facts of work values: a structural analysis of work outcomes. *Journal of Applied Psychology*, 69:379-389.
- [3] Feng, S. and Li, D. (2009) The research on work value structure of public welfare scientific institutions in China. *Chinese Journal of Ergonomics*, 2:9-13.
- [4] Locke, E. and Henne, D. (1986) *Work motivation theories*. International review of I/O psychology, New York.
- [5] Pryor, R. (1998) Differences among differences-in search of general work preference dimensions. *Journal of Applied Psychology*, 72:426-433.
- [6] Shuler, R. and Jackson, S. (1988) Linking remuneration practices to innovation as a competitive strategy. *Human Resource Australia*, 5:196-211.
- [7] Super, D. (1980) A life-span, life-space approach to career development. *Journal of Occupational Psychology*, 52:129-148.

# Average Life Prediction for Aero-Engine Fleet Based on Performance Degradation Data

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**Abstract:** The purpose of this paper is to describe an approach to reliability life prediction, applicable to the aero-engine fleet, operation under dynamic conditions. The fleet performance reliability model based on Weibull distribution is established through measuring and recording the extent of deviation and degradation from a normal operating condition of aero engine fleet. The average life and performance reliability control method of the aero engine fleet are obtained under dynamic environment by introducing the concept of performance reliability which linked the reliability and actual performance. On-line, real-time applications of performance reliability prediction are useful in operation control as well as predictive maintenance.

## 1. INTRODUCTON

Currently, traditional reliability modeling methods are adopted in aero-engine life prediction mostly[1-7]. But traditional approaches to reliability modeling are based on analysis of historical life-test data. Such estimates result in models reflecting population characteristics, typically under given conditions. These models are very useful during system definition and design phases, but are of limited usefulness in day to day operational phases. Especially for aero engine, manufacturers analyzed a large number of global data and used traditional approaches to reliability modeling, which got different models for different engine types. But due to the differences of utilization, the use of the environment and maintenance level of airplane and so on, the models given by manufacturers just only as a reference can not be used to control the Q-percentile life of aero-engine exactly for the isolated case. Therefore, it is necessary to study the residual life prediction method for aero-engine on-wing applicable to China's actual condition of airlines whose aero engine fleet sizes are generally smaller than foreign airlines relatively.

Performance degradation processes contained a large number of credible, accurate, useful and key information of life. Few researchers developed reliability control methods by introducing the concept of performance reliability which linked the reliability

and actual performance applying on different fields [8,9]. In this paper the fleet performance reliability model based on Weibull distribution is established through measuring and recording the extent of deviation and degradation from a normal operating condition of aero engine fleet. The average life and performance reliability control method of the aero engine fleet are obtained under dynamic environment by using the similar method and assumption that performance degradation is Gaussian random process.

## 2. Real-time performance reliability modeling theory

Five conditions need to be met when real-time performance reliability model is build. [8] They are: (1) Let malfunction or failure may be defined in accordance with physical measurements. Failure is usually manifested in the physical signal and the information of possible failure are usually hidden in the changes of performance. Therefore, the link between the failure and signal need to build. (2) A real-time online data sensors and transmission system is needed in order to provide real-time performance data. (3) The time series of observed values is equally spaced; (4) Systems or components in a normal working state (non-failure or fault condition) when Model is build; (5) Physical measurements sampled according to the schedule is a random process and can be tracked as a time series.

According to the definition of life variables, the product failure distribution function is as follow:

$$F(t|\mathcal{G}) = P\{T(\mathcal{G}) \leq t\} \quad (1)$$

This is a complete description of statistical principle of the product degradation failure, called degradation failure model. According to the definition of failure caused by the degradation, when the degradation measurement is typical of the upward trend, the relationship between degradation failure model and degradation measurements can be obtained as follows:

$$F(t|\mathcal{G}) = P\{T(\mathcal{G}) \leq t\} = P\{x(t) \geq \mathcal{G}\} = 1 - G(\mathcal{G}, t) \quad (2)$$

If the product failure density function is signified

by  $f(t|\mathcal{G})$ , the relationship between the distribution of product life and the distribution of degradation measurement is as shown in Figure 1. It is in a similar situation when the degradation measurement is typical of the downward trend. In the case of without confusing,  $F(t|\mathcal{G})$  and  $f(t|\mathcal{G})$  can be written  $F(t)$  and  $f(t)$  respectively.

For the samples measured at the same time, the distribution of degradation measurement is  $G(x, \Theta(t))$  and the corresponding density function is  $g(x, \Theta(t))$ , where the parameter vector is  $\Theta(t) = (\theta_1(t), \theta_2(t), \dots, \theta_p(t))$ . Supposed that the product degradation failure threshold is signified by  $\mathcal{G}$ , the product occurs degradation failure when  $x(t) > \mathcal{G}$ . Let  $T$  denote the time of the product degradation failure,  $F(t)$  denote the product failure probability function at time  $t$ , and  $f(t)$  denote the corresponding density function of failure. According to the equation (2), we can get [8]:

$$F(t) = 1 - G(\mathcal{G}, \Theta(t)) \quad (3)$$

To obtain the performance degradation data, the product is continuously measured at the different time  $t_1, t_2, \dots, t_n$ . If the available data can not strictly meet the rules of a continuous measurement condition and equal space, they need to be processed by the methods such as Mean Interpolation, Similar Mean Interpolation, Maximum Likelihood and Multiple Imputation.

The basic steps of the reliability analysis method based on performance degradation data are as follows:

Step1. Analysis the failure mechanism, identify the key performance parameter or degradation measurement and the failure threshold.

Step2. Collect the degradation data in accordance with the appropriate intervals, analysis the distribution of degradation measurement at each time point and select the appropriate distribution  $G(x, \Theta(t))$  to describe the distribution of degradation measurement at time  $t$ . The parameters of distribution are time-varying.

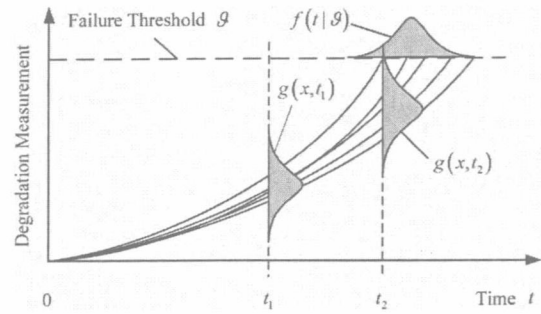


Fig. 1. the relationship schematic diagram between  $t$  life distribution and degradation measurement

Step3. Determine the estimated value  $\hat{\Theta}(t)$  of parameter vector  $\Theta(t)$  at each measurement time  $t_j$  ( $j = 1, 2, \dots, n$ ).

Step4. Using the distribution of degradation measurement  $G(x, \Theta(t))$  at time  $t_j$  and failure threshold  $\mathcal{G}$ , we can obtain the failure probability  $p_j$  by equation (3) at the same time. Using this method, a series of data  $\{(t_j, p_j) | j = 1, 2, \dots, n\}$  can be acquired.

Step 5. Using the data  $\{(t_j, p_j) | j = 1, 2, \dots, n\}$  and regression analysis techniques to solve the estimated value of the unknown parameters in product failure distribution. Then reliability can be analyzed by the estimation results.

### 3. Average life prediction method based on performance degradation data of aero-engine fleet

Performance degradation is the result of gradual change within the materials under the effect of the constant external force. As randomness of the external environment and internal material, the degradation measurement is also random at measure time. Therefore, we can make use of stochastic process model to describe the product's performance degradation. According to the definition, causes and attainability of recession, EGTM (Engine Gas Temperature Margin) is selected from engine performance parameters as the analysis target. By analyzing EGTM degradation, the performance reliability of civil aviation engine is assessed.

#### 3.1 Assumption

The degradation data of the engine comply with the following assumptions:

- 1) EGTM failure threshold value is 0. The function failure is defined when the EGTM researches 0.