数字化消费与制造业数字化转型

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摘　要：数字化消费是指由产品和服务搭载的数字内涵和数字特性所引致的消费，具有数字技术基础配置依赖性强、需求易于精准把控、新业态新模式适应性和灵活性强、消费体验反馈速度快且修正时效短、市场潜力大等特征。在科技赋能和消费升级双重驱动下，我国数字化消费快速增长、数字化赋能传统消费领域、数字内容消费不断拓展与延伸、下沉市场数字化消费潜力逐步释放、新生代消费群体的影响力日益增大，呈现出消费主体数量大范围广、新型消费业态细化、消费服务深化、基础配置逐渐完善等态势。数字化消费不断呈现的大规模突破和拓展，形成越来越有力的需求牵引，驱动产品和服务创新，驱动企业内部流程及工艺数字化转型，驱动企业组织结构变革和决策模式转变，带动产业链升级与重构，促进商业模式创新，最终通过提升用户体验和企业运行效率，实现制造业发展在质量、效率和动力等方向上的根本变革。但是，面对数字化消费的迅猛发展和强力牵引，制造业数字化转型仍然面临着若干问题与挑战的抑制和束缚，应进一步深化以用户为核心的发展理念与价值创造模式，针对消费者个性化、差异化、多元化需求，依托持续的全流程智能化数字化升级进程，构建差异化服务体系，优化数字资源配置，强化品牌数字化管理能力，全面提升基于产品与服务的研发创新和价值创新能力。

关键词：数字化消费；制造业；数字化转型

JEL 分类号：O14, O33

数字经济时代，数字技术与实体经济不断融合，成为推动经济增长和市场运行深刻变革的新动能和新力量。以产品和服务的数字内涵为对象的数字化消费在中国显示出强劲的增长潜力，不仅有效推动了消费扩容提质，也给企业在供给侧结构性改革中带来了新的发展机遇。新形势下，加快推进产业数字化进程，实现产业质量变革、效率变革、动力变革，必须充分发挥数字化消费在产品和商业模式创新以及内在流程、组织架构、产业链体系改造升级等方面的牵引带动作用。

一、数字化消费的内涵与特征

新一代信息技术的快速发展有力刺激和催生了消费领域商业模式的迭代创新，极大改变了消费生态体系。从消费者搜寻信息、比较选择、支付结算，到物流供应链、生产制造，乃至基于消费心理

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和潜在需求挖掘之上的新产品开发，互联网、大数据、云计算等数字技术被广泛应用，作为消费对象的产品和服务被注入越来越多的数字内涵。所谓数字化消费就是指由产品和服务搭载的数字内涵和数字特性所引致的消费。在数据要素的驱动下，消费者的购买习惯、消费行为和生活方式被数字技术所渗透和改变，数字化消费与传统消费的区别也更加显著。

（一）数字技术基础配置依赖性强

技术基础是数字化消费的根基，从市场挖掘、平台搭建、品牌建设以及消费服务等各个环节对数字技术基础配置的依赖性普遍较高。市场挖掘方面，企业需要运用数字营销网络和数据挖掘分析手段构建用户画像和需求预测模型，从而深度挖掘市场需求，引导消费者扩大消费；平台搭建方面，数字平台是连接供应端和消费端的重要渠道之一，在满足消费者多层次多样化消费需求的同时，也能帮助供应端减少部分成本，加大研发创新投入；品牌建设方面，利用数字化消费提供沉浸式、体验式、互动式场景的优势，实现精准定位消费群体，优先选择不同群体的规模和价值，有针对性地开展品牌建设；消费服务方面，通过线上线下融合实现全域营销，支持消费前、中、后阶段的专业化服务，利用第三方监督跟踪，进一步完善消费体验。

（二）需求易于精准把控

通过合理使用数据要素，可以精准把握和引导消费主体需求。第一，算法推荐技术发挥重要作用。算法通过个性化推送、排序精选、检索过滤等技术方式满足人们多元化、个性化的信息需求，帮助企业实现用户与信息的快速精确匹配。第二，数字沉浸互动模式带来更好的消费体验。数字技术可以为消费者提供沉浸式消费体验，例如，通过虚拟现实等数字技术，可以借助购物平台实现穿戴体验，可直观感受到产品与服务，进一步增强购物的真实感和愉悦感。另外，部分线上平台设立社区服务，能够为消费者精准地找到相同爱好的用户，提供更多互动服务。第三，数字技术以消费者为中心，提供更多个性化服务。基于大数据分析和互联网技术，根据消费者需求，精准实现供需匹配，满足消费者个性化需求。与此同时，企业借助平台分析，评估供应链能力，降低库存风险压力，预判消费者需求，提供更加精准的产品和服务，实现以消费者为核心、精准高效决策的高质量发展新模式。

（三）新业态、新模式适应性和灵活性强

数字化使得消费方式和产品服务发生改变的同时，也促进了以网络购物、直播带货、数字文化等消费新业态、新模式的出现，并且逐渐占据消费市场较高比重。线上线下的深度融合，加速产生了更多适应性和灵活性都较强的数字消费场景。新业态的适应性强是由于数据要素的充分利用使得为消费者提供更为个性化的服务，新业态需要一定的消费者基础背景，在进入市场的初期，能够快速适应市场。另外，平台购物、直播带货、线上团购、互联网+等依托于数字化技术的消费新业态、新

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模式，基于其方便、高效、快捷等特点，消费灵活性较高，消费主体可以根据自身需求，随时随地选择适合自己的方式，不再局限于传统消费的模式，提升了产品供应端有效获得所需信息、增强自身质量水平的灵活性和便利性，有利于产品服务以及供应模式的发展。

（四）消费体验反馈速度快、修正时效短

随着互联网应用的快速发展，消费渠道和方式也出现多样化，消费体验反馈对提高竞争力和提供更好服务起到重要作用。数字化背景下，一方面，商家能够及时高效地获取消费者反馈，售后服务反馈速度快，消费者线上消费跟商家沟通成本低，有效解决了消费服务问题，消费者得到更好体验。另一方面，对供应商来说，借助数字化技术，满足用户体验和提升企业效率，能够节约企业成本，数据要素分析可以重构供需两端的联系，供应商通过用户属性和推荐算法给消费者提供更适合的产品和服务，完善用户体验，也能够缩短服务修正时效，进一步提升产品服务和竞争力。

（五）市场潜力大

数字技术已经全面渗透到生活的方方面面，带动数字化消费潜力不断扩大。利用数据挖掘和资源处理等手段，企业可以更加有效地细分市场，根据用户需求的异质性特点，更加有效地集中资源进行市场竞争。在数字化消费条件下，根据消费者属性、行为等因素，提供有针对性的、差异化的产品和服务，最大程度地挖掘市场潜力、创造顾客价值。此外，由于数字化消费的独特优势，可为消费者提供的消费渠道和方式越来越多元化，从传统进店消费到线上消费，从图片主导消费到直播试用消费的不断转变，消费方式从消费者按需搜索消费转变为根据图片视频等方式“种草”消费，也在客观上刺激和放大了消费需求，赋予市场以更大的消费潜力。

二、我国数字化消费的发展现状与态势

随着互联网、云计算、人工智能等新技术在消费领域的广泛渗透与应用，在科技赋能和消费升级双重驱动下，各种以发展型、享受型和品质型消费为内核，以数字化、网络化和智能化为手段的新业态、新模式、新场景和新服务蓬勃发展；这类新兴的数字化消费呈现较强的创新性、成长性和适配性，日益成为我国消费增长的关键环节和重要引擎。

（一）数字化消费快速增长

在全球新冠肺炎疫情反复延宕的背景下，以网络购物、直播、数字文化、在线医疗等为代表的数字消费新业态、新模式持续发展，数字化消费比重快速提升，已成为中国经济增长新旧动能转换的主要动力之一。截至2022年6月，我国网民规模达到10.51亿，互联网普及率升至74.4%，网民使用手

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机上网的比例为99.6%。[①]互联网深度融入人民日常生活。截至2021年12月，网民每周平均上网时长28.5小时，比上年同期增加2.3小时。网络购物用户规模不断上升。截至2021年12月，我国网络购物用户规模达8.42亿，比上年同期增长5968万，占网民总人数的81.6%；网上外卖和网约车成为用户规模增长最快的两类应用，用户规模分别达5.44亿和4.53亿，分别比上年同期增长29.9%和23.9%。[②]2021年，全国网上零售额达13.1万亿元，比上年增长14.1%，其中实物商品网上零售额占社会消费品零售总额比重的24.5%。网络零售作为打通生产和消费、线上和线下、城市和乡村、国内和国际的关键环节，在数字化消费增长中不断发挥积极作用。

（二）数字化赋能传统消费领域

巩固好传统消费优势、利用数字化技术使其焕发新机成为促进消费、满足消费者个性化需求中的重要一环。依托数字化、信息化等新技术的推广应用，传统意义上的商圈及商业企业通过建构沉浸式、体验式、互动式等系列消费场景，推出包括智慧商店、智慧餐厅、无接触配送、情景式消费等在内的新业态、新模式、新体验，着力推进智慧化改造。从家电、家具、汽车、餐饮这四类占据社会零售总额1/4的传统消费“四大金刚”来看，数字化赋能有望释放更大潜力。互联网平台为购车带来了极大的便利，通过虚拟实景技术，可以带给消费者沉浸式消费体验。家具家电行业线上消费已非常普遍，除了可以提供多样化选择外，也可以根据消费者时间等其他因素选择定时定点上门安装，保障售后服务。餐饮企业积极同外卖、电商、直播等平台合作，拓展线上盈利渠道，同时推动餐厅场景化升级，严格把控食材质量，继而优化消费体验，加快数字化转型升级。

（三）数字内容消费不断拓展与延伸

在数字化消费浪潮的带动下，随着在线健康医疗服务、在线文娱、在线健身、在线旅游等“互联网+服务”服务新业态快速发展，消费者对相关数字服务和产品的需求不断增长。以在线医疗为例，截至2021年12月，我国在线医疗用户规模达到2.98亿人，同比增长38.7%，成为用户规模增长最快的领域之一。“云计算”技术催生出了新型休闲娱乐消费方式，如云旅游、云逛展、云养宠等满足“宅经济”背景下消费需求的“云消费”成为重要的数字化消费内容之一。另外，智能健身、云赛事、虚拟运动等新兴运动促进全民健身寻找到新的突破口，健身场所越来越“智能”，健身服务越来越“智慧”，也会让全民健身越来越“尽兴”。受疫情影响，利用数字技术推动线上排队、直播购物、线上办公等通过大数据分析消费偏好等数据，为消费者提供更好的消费体验。数字消费产品内容和服务的不断丰

① 中国互联网络信息中心：《第50次中国互联网络发展状况统计报告》，http://www.cnnic.net.cn/n4/2022/0914/c88-10226.html。

② 中国互联网络信息中心：《第49次中国互联网络发展状况统计报告》，http://www.cnnic.net.cn/n4/2022/0401/c88-1131.html。

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富，给消费者带来与传统线下消费不同的体验感和参与感，也为供应端深挖市场潜力提供动力，将为推动消费升级提供新的增长点。数字内容消费的不断拓展与延伸，催生了新业态、新模式，扩大了消费覆盖面，同时拉动城乡的消费升级，赋能新消费场景，构成了数字化转型的重要支撑。

（四）下沉市场数字化消费潜力正在释放

随着经济发展水平持续提升、城镇化进程不断推进、基础设施建设和物流体系不断完善、居民可支配收入增加，下沉市场展现出前所未有的消费潜力。2022年上半年，在上年行政村实现“村村通宽带”的基础上，我国又实现了“县县通5G”。截至2022年6月，农村网民规模达2.93亿，农村地区互联网普及率为58.8%，[③]城乡互联网普及率差距由2012年底的36.1%降至21.6%，城乡“数字鸿沟”明显缩小。截至2021年底，全国农村公路里程446.6万公里，比上年末增加8.4万公里，其中乡镇通三级及以上公路比例达82.2%、提高1.4个百分点；农村快递服务营业网点数量占比提高至30%以上，快递服务乡镇网点覆盖率达到98%[④]；1300多个县实现了电子商务全覆盖；建成县级电商物流配送中心2000多个。2014~2021年，农村网络零售额从1800亿元增加到2.05万亿元，增长了10余倍，占全国网络零售额比重由13.6%升至15.7%。线上教育、线上医疗、视频娱乐等服务消费在农村地区兴起，极大丰富了农村居民的精神文化生活，也带动了乡村数字化消费由物质消费向服务消费的拓展与升级。

（五）新生代消费群体的消费影响力不断增大

新生代消费群体，也称Z世代(Generation Z)，一般指1995~2009年出生、深受互联网影响的一代人。根据国家统计局数据计算，我国1995年~2009年累计出生人数约为2.6亿，占2021年总人口的

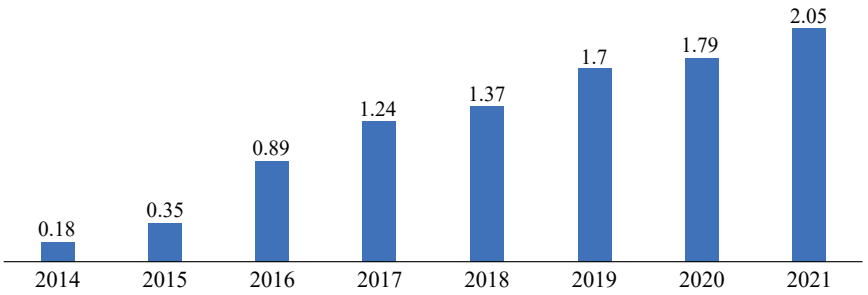

图1：2014~2021年全国农村网络零售额（万亿元）

资料来源：商务部。

[③] 中国互联网络信息中心：《第50次中国互联网络发展状况统计报告》，http://www.cnnic.net.cn/n4/2022/0914/c88-10226.html。

[④] 交通运输部综合规划司：《在加快建设交通强国新征程上建新功—〈2021年交通运输行业发展统计公报〉评读》，《交通财会》2022年第6期。

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18.4%。不同于以往其他消费人群，新生代消费者具有极为鲜明的消费特征：一是愿意消费，敢于消费，消费收获的快乐体验高于消费品本身的功能效用，购买物品与服务不只是需求的满足，更是对生活方式的追求。二是更注重消费过程中的社交属性，即通过社交型消费，在其归属的网络圈层获得自我认知与群体认同，以及求得心灵上的共鸣与情感上的慰藉。三是消费行为更加个性化、特色化以及多元化。他们希望通过购买与消费不同的产品来凸显独特个性，打造专属的人设。对于多元文化观的执着追求使得不少小众文化的圈层不断扩大，“小众即大众”是这种消费心理的最生动展现。四是消费决策时更强调商品的文化内涵与价值建构，愿意尝试各种新鲜事物，敢于为产品的文化价值买单。随着新生代消费人群逐年进入职场，迎来事业的起步与快速上升期，其所蕴藏的消费能量也随之不断释放。新生代消费者是数字原住民，他们对数字化消费的影响不仅仅是在规模扩张上的强力拉动，更以其鲜明的消费特征、独特的消费方式以及更加个性化、特色化和多元化的消费选择对消费市场结构产生颠覆性的影响。

总的来看，我国数字化消费呈现出消费主体数量大、范围广、新型消费业态细化、消费服务深化、基础配置逐渐完善等态势。随着数字化的渗透，消费主体范围将进一步扩大，市场体量快速增长，供应端与需求端协同发展，用户参与产品的创新和服务的研发设计，深度参与品牌价值创建，为数字化消费创造成长空间，加速数字技术与传统产业融合发展。

三、数字化消费带动制造业数字化转型的机理与路径

新一轮科技革命和产业变革的深入推进不仅创造了一大批快速成长的新兴技术领域和新兴产业，也为我国制造业提供了“换道超车”的数字化转型新机遇。在数字经济条件下，数字化消费在更多方向上不断出现大规模突破和拓展，形成越来越有力的需求牵引，带动制造业充分借力数据资源的赋能作用，驱动产品和服务创新，提升用户体验和企业运行效率，实现质量变革、效率变革和动力变革。

（一）驱动数字化产品和服务创新

在数字化消费背景下，消费者个性化、差异化需求不断被激活和挖掘，市场潜力也随之逐步被释放，不仅成为企业价值创造的对象，也成为牵引产业变革创新的外在动力。数字化消费规模扩大、消费市场的快速成长、零售网络的普遍铺设和在线支付体系的完善，拉动和倒逼制造业数字化产品和服务的创新。第一，利用数据要素分析可充分挖掘消费者需求。运用大数据和云计算等现代信息分析技术，有利于制造业供应端精准改善用户服务体验，开发创新产品。第二，企业价值获取过程能够得到有效缩短。借助于数字技术，各个环节获取价值的时效提高，在降低成本的基础上实现收益的最大化，进一步提升产品服务创新能力。第三，数字化消费体验反馈可减少企业创新研发时间，为企业节约一定的时间成本以及售后信息的搜集成本。

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（二）推动企业内部流程及工艺数字化转型

数字化消费使更多个性化、差异化需求从隐性变为显性，更具经济价值和规模效益，能够推动企业加快内部流程及工艺数字化转型升级，促进数字技术在研发设计、生产加工、市场营销及售后服务等全过程的深度应用，实现全流程业务数字化转型。在企业利用数字化技术全面整合企业内部流程后，通过全流程数据分析，加快全价值链业务协同，提升企业整体运行效率。另外，工艺是制造业整体素质和竞争力的根本体现，突破数字化工艺转型升级制约，有利于构建可靠的供给体系。数字化消费行为和数据分析为工艺技术攻关提供了方向和基础，数字化布局促进了工艺改造、流程优化以及产品高质量产出。数字化溯源是引导企业提供质量管理、监测检查、运维预测等的基础保障。

（三）牵引企业组织结构变革和决策模式转变

数字化消费是沟通数字产业化、产业数字化的桥梁，以及培育新型消费、全面促进内需释放的重要工具。在数字化发展背景下，企业组织结构从传统的“金字塔”形转变为效率更高、更加符合数字化发展背景的新型管理模式，组织结构的转变改变了传统命令链的多层级和复杂性，更有利于信息的传递，保证信息传递的有效和真实，进一步提高了组织效率。企业内部各管理层在数字化思维、数字技能和数据管理等方面能力的不断提升，有助于推动企业打造一体化数字管理平台，形成数据驱动的智能决策，帮助企业实现数字化转型。通过线上线下数据资源结合，企业战略决策转变为由数字化标准支撑把握发展方向的重要决策。管理决策通过数字技术开展标准制定和监测评估而做到精准决策；业务决策面向数字化消费主体实现了有针对性和有计划性的精准施策，提升企业数字化管理水平，挖掘市场消费潜力，增强自身竞争实力。

（四）带动产业链升级与重构

当前，我国制造业在加工制造环节的传统优势面临巨大挑战。人口红利减少、要素成本上升等都给传统制造业带来发展阻碍。产业链关键环节的技术水平成为转型升级的关键点之一。数字化消费能够带动制造业企业从研发到销售，从内部设备到运营管理等价值链体系的升级与重构。第一，数字技术帮助制造业企业降低综合成本。随着大数据、人工智能等数字技术的突破，生产过程中间产品成本得到大幅度缩减和降低，为产业链供应链优化升级提供动能。第二，推动产业链数字化转型升级。数字技术与产业链深度融合，能够有效提升产品质量的稳定性和可靠性，满足更多用户个性化、差异化需求。第三，增强产业链供应链韧性。先进数字技术的应用提高了生产线柔性，能够根据消费需求进行产业链供应链调整，增强了企业对市场变化的响应速度，实现产业链供应链高效、低成本运营模式。利用数字化技术，加快提升制造业核心竞争力，防止制造业外迁，巩固传统产品出口优势，支持企业开拓国际市场。

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（五）用户参与、价值共创促进商业模式创新

在数字化背景下，商业模式发展由以产品和服务为核心的发展转变为以用户参与、消费者为主导的发展。只有提升用户参与感、幸福感的产品和服务，才能真正满足消费者个性化和差异化的需求。基于数字化技术对消费者需求分析，可以为用户和自身带来新的创造价值。对消费者来说，用户参与改变了传统被动接受产品和服务的角色，而且主动参与产品和服务的制造，充分感受个人价值的实现。这种独特体验极大地增强了产品和服务对用户的粘性。对供应端来说，用户参与企业产品和服务的设计、研发、制造等过程，在一定程度上也降低了企业的运营成本。由于用户参与和价值共创，对深入挖掘消费需求，增强企业的市场竞争力提供了极为重要的指引，不仅使企业运营体系更具外向性和开放性，更有可能实现价值创新。充分体现和对接消费需求的商业模式创新更具整体性和系统性，更不易被竞争者模仿，也就更具竞争优势。

四、数字化消费带动制造业数字化转型面临的问题与挑战

随着数字时代的到来，数字化转型已经成为中国制造业打破生产成本攀升、创新能力不足、产品与服务质量亟待提高等深层次问题困扰，以及真正摒弃依靠要素驱动和低成本竞争增长模式的必然选择。然而，面对数字化消费的迅猛发展和强力牵引，制造业数字化转型仍然面临着若干问题与挑战。

（一）对数字化转型认识不到位，顶层设计不清晰

对于传统制造业企业来说，对数字化转型认识还不到位，缺乏战略规划和数字化转型经验。第一，对以数字化消费者为核心的创新发展认识不清，没有重视满足数字化背景下消费者个性化和差异化的需求，导致其发展滞后；第二，对数字化转型急迫性和颠覆程度认识不足，部分制造业企业存在一定的侥幸心理，不愿做出深刻变革以迎合当前市场变化，没有及时进行数字化转型而导致逐渐失去市场生存空间；第三，对内部资源能力和外部市场环境认识不清，传统制造业企业对自身资源和创新能力认识不足，无法合理地与数字化消费市场匹配研发产品与服务，面对外部市场环境，企业无法适应快速变化的技术市场，对供需不确定性变化没有预判，容易对市场机会反应迟缓。另外，当前国家高度重视数字经济产业发展，强力推进制造业企业数字化转型升级，但对具体企业数字化转型目标、需求、路径和实施步骤不明确，顶层设计不清晰。一是制造业企业转型目标和方向难以把控，传统企业长期发展状态不易转变，对颠覆性数字化转型升级目标难以确立，没有进行长远布局；二是缺少整体战略规划和清晰的转型思路，各业务系统封闭运行，缺乏集中控制模式，没有形成统一的管理机制，难以实现资源信息共享；三是顶层设计需不断完善进步，数字化转型需根据市场和技术情况不断地进行改进和积累，对总体性、大局性、系统性把控有重要要求。

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（二）数字化转型基础薄弱，数据要素利用不充分

企业规模大、以加工为主的制造业企业运营发展模式单一，需进行数字化转型提高企业竞争力，但当前制造业企业数字化转型基础普遍薄弱。一是数字化市场识别能力较差，面对快速发展的数字化消费市场变革，制造业企业缺少快速获取前端消费者需求的能力，无法把握新的消费理念和多样化用户需求带来的机遇；二是数字技术应用能力较差，制造业企业按照传统模式运行发展已久，利用数字技术管理和创新发展能力较差，各行业差异较大，缺少数字化建设的经验和指引，无法快速运用数字技术转型升级；三是数字信息整合能力较差，传统制造业是单一资源的运用，在数字化消费背景下，需要充分整合各方信息资源，提取对企业发展有利的信息，达到提升自身竞争力的目标，当前该能力有待提升。另外，数据要素在数字化转型升级的过程中至关重要，缺乏充分利用数据要素的能力，不利于制造业企业数字化发展。首先，数据要素市场体系不健全，数据资源确权、定价等信息企业掌握不完全，数据应用产生了一定的阻碍；其次，数据要素开发利用意识不强，数据要素对深入挖掘市场，激发消费者潜力有重要作用，当前企业对数据要素价值认识不到位，缺少运用数据要素创造产品和服务的能力；再次，利用数据要素不充分，难以通过数据适应不同消费群体特性，不利于数字化转型升级整体规划和确立创新方向。

（三）产业数字化支撑体系不健全

对传统企业来讲，数字化转型需要全方位、全链条发展，提升各环节数字化水平，提升全要素生产率。研发设计方面，缺少消费者数据要素赋能，无法精准定位研发设计的改进方向，容易丢失市场机遇。生产制造方面，工艺提升和强化质量都离不开利用智能化和数字化手段对传统工艺的优化提升，当前制造业中低端产品产能过剩，在质量上存在一定差距，需要通过数字化强化产品工艺和质量。经营管理方面，内部流程环节体系封闭给经营管理带来极大挑战，整合全流程数据信息能力较弱，需加快推进数字化办公、智能化监测等应用措施来推动制造业数字化转型。另外，企业普遍面临数字化转型资金投入不足的困扰。一是企业对数字化转型资金投入缺乏有效设计，缺少全流程数字化转型资金所需投入整体规划，对全流程成本把控不清；二是各类专项资金采用财政后补助、后奖励方式，没有达到集中财力办大事效果，也没有起到有效的引导和撬动作用；三是资金投入回报周期长，短期内不易看到投入产出的实际效果，也会削弱企业转型的战略决心。

（四）产业数字化人才短缺，储备严重不足

当前，数字化人才短缺已是众多行业数字化转型遇到的普遍性难题。仅掌握信息技术已远不能满足数字化发展对人才的需要。企业最急需的是既对产业现实有深刻理解与把握，又能突破已有认知束缚、横跨多领域的复合型人才。从制造业来看，在数字化转型中面临的人才不足问题主要体现

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在：一是与制造业企业数字化转型升级需求契合匹配的人才不足。由于制造业行业众多，行业特点不同，其转型的目标和方式有差异，能够与具体行业企业高度匹配的人才较少，能够帮助企业精准完成有针对性数字化转型升级要求的人才缺口较大。二是数字化人才培养成本较高。制造业企业大多面临两种人才，有数字化基础无行业经验或无数字化基础但行业经验丰富的人才，培养任何一种人才都会给企业带来一定的成本负担，并且可能出现成本投入后人才流失的风险，导致企业不愿花费高成本投入人才建设。三是制造业企业负责人数字化基础较弱，对数字化技术了解较少，无法制定出符合企业发展的数字化转型计划。四是数字技能人才培育周期长，与高校学生开展培育联动机制，打造适合企业发展需求的人才储备队伍，还需考虑培养周期和能力匹配的问题。

五、发挥消费牵引作用、推进制造业数字化转型的对策与建议

数字化转型的本质和关键在于为用户创造新价值。数字化消费从需求侧“倒逼”企业深入挖掘和利用数据资源，感知捕捉需求变化，刺激催生新业态新模式，客观上提供了创新产品和商业模式的方向和机遇。加快推进产业数字化进程，应进一步深化以用户为核心的发展理念与价值创造模式，针对消费者个性化、差异化、多元化需求，依托持续的全流程智能化数字化升级，全面提升基于产品与服务的研发和价值的创新能力。

（一）依托数字技术赋能，强化新产品研发能力

结合数字技术与制造业融合发展能力，依托数字技术基础，提升制造业企业数字化研发设计水平，提升产品和服务的竞争力、品牌的影响力。第一，增加创新产品数量。通过深度挖掘数据要素价值，精准定位消费者需求，提升数字化技术，进行创新产品开发，大力支持产业链协同创新、知识产权服务平台建设以及智能产品开发应用。第二，推进数字化研发。加快数字化全产业链信息协同，鼓励开发自主研发创新产品，建立创意素材数字资源数据库，推广应用协同创新、用户参与等新模式，建立数字化设计公共服务平台，为实现资源信息高效使用提供动能。第三，重塑产品开发生产模式。整合生产端和消费端数据资源，建立供应和需求联动机制，开展协同制造创新模式，深入挖掘用户个性化、差异化需求，构建消费驱动型组织模式，推动个性化生产与精准供应新模式，实现数字化技术对产品服务消费赋能。第四，推动数字化和绿色化协同供给。推进产品绿色设计与制造一体化，依托数字化技术创新开发绿色产品，提升绿色制造水平，扩大绿色供给，发展基于“互联网+”“智能+”的回收利用与共享服务新模式。

（二）推进数字化智能化改造升级，提升产品品质和市场竞争力

以数字化消费为牵引，带动传统制造业全链条数字化智能化转型升级，优化产品和服务的质量

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与性能，改善用户体验，提高满意度。第一，加大数字化改造力度。引导企业聚焦研发设计、生产制造、经营管理、市场服务等全周期数字化转型，加快智能化升级和关键技术应用，提升数字化管理能力，推行企业“上云上平台”，加快数字化转型。第二，加强数字化追溯体系建设。面对特定行业，利用数字技术推动质量追溯体系建设，鼓励企业利用现代化信息技术开展原材料供应、产品生产、营销等各环节数字化溯源，充分利用追溯数据，提供智能监测和运维维护，优化管理体系，提升产品品质，增加用户粘性，提升社会公众认知度，助力提振消费信心。第三，深化智慧供应链管理。加快数字化技术装备应用，推动实现关键环节数据集成共享，开发建设智慧供应链服务平台，打造全方位供应链管理体系，提升供应链协同管控能力。

（三）推进研发设计与品牌建设融合发展，强化品牌数字化管理能力

提升数据资源管理与分析能力，优化品牌管理流程，实现生产研发与品牌推广同步推进，增强品牌影响力和国际竞争力。第一，借力数字技术加快培育品牌建设。积极促进产品设计、文化创意、技术创新与品牌建设融合发展，深度挖掘品牌文化价值内涵。第二，推动企业运用数字化营销。深入挖掘数据要素，构建用户画像和需求预测，培育引导时尚消费的新品牌，鼓励企业推进智慧商店建设，打造多元化消费场景，满足消费者全方位需求，实现品牌精准定位，提升品牌感知和社会价值。第三，加大数字化转型公共服务供给，为品牌建设提供良好环境。促进数字技术在品牌建设全过程中提供深度服务，优化品牌管理流程，实现线上线下协同，依托跨境电商扩大品牌影响力，开拓多元化市场。第四，提升品牌影响力。利用数字化营销手段，突出特色优势，助力品牌宣传推广，打造有影响力和产品附加值的品牌，提升品牌知名度。

（四）构建差异化服务体系，助力制造业数字化转型

数字化赋能制造业产品和服务发展已经成为高质量发展的必由之路。积极发展数字化转型，深度挖掘数据资源价值，面对消费者个性化特点，提供满足其差异化、多元化的需求。第一，提升数据要素开发利用能力。以实际应用需求为导向，促进数据与产品服务创新开发深度融合，加快提升数据处理能力，实现各环节全数据信息互通互操作，根据数字技术采集信息，精准定位用户需求，从而满足不同消费主体的需求。第二，完善产品服务各环节数字化水平。从产品推广到交易业务，强化数字化服务理念，让用户参与设计研发，提升个人价值感，建立交流社区满足用户社交需求以增加用户粘性，提升交易业务数字化水平，拓展线上售后追溯渠道，在满足差异化服务需求的同时增加用户体验感。第三，构建安全高效、合作共赢的服务模式。建立健全开放平台的安全管理机制，提升风险监测智能化水平，通过数字化转型拉近与消费者的距离，让用户体验到合作共赢的服务，降低企业运营成本，结合个性化属性，提供精准服务。第四，建立消费者反馈奖励机制。消费者前期需求与

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售后反馈数据资源是提升产品和服务创新发展的优质资源，鼓励消费者反馈体验感和需求，在提升用户获得感的同时也增加了用户粘性。

（五）完善顶层设计规划，优化数字资源配置

制定清晰的发展规划路线对企业数字化转型具有重要意义。第一，建立数字化转型的顶层设计规划。明确数字化转型的目标，将数字化转型目标、转型方向、转型路径和实施步骤落实到全体人员；建立完善的人才引进、评价配套体系，探索和完善人才培养模式，培养储备数字化专业人才。第二，优化资金投入方式。在数字化转型中，应着重聚焦核心产业，精准发力，打造转型标杆企业。第三，大力推动企业“上云”，加快各类信息技术在企业中的普及应用，强化企业各类资源在“云”上集聚，提升生产管理效率，促进业务协同，优化资源配置，为构建数据驱动的新生态提供支撑。第四，加快推动供应链各环节实施数字化转型，实现供应链上下游打通数据渠道，整合数据链、创新链、产业链。此外，还要充分利用科研院所、高校、专业机构的数字技术研发资源，支持数字经济领域重点实验室、技术创新平台建设，深入布局数字产业核心领域，实现核心关键技术突破。

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Digital Consumption and Manufacturing Industry's Digital Transition

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Abstract: *As a form of consumption based on the digital content and traits of goods and services, digital consumption is characterized by a strong dependence on the digital technology infrastructure, precise identification of consumer demand, adaptability to new business modes, swift consumer feedback and response, and great market potentials. Under the dual driving forces of technology empowerment and consumption upgrade, China's digital consumption has been growing rapidly, digitalization is empowering traditional sectors of consumption, and the consumption of digital content is expanding. Consumer potential for digital consumption is being unleashed in low-tier cities, and new-generation consumers are gaining influence. With an increasing number of digital consumers, new consumption modes and services have proliferated thanks to the improving digital infrastructure. Growing digital consumption has created an increasing demand-pulling effect that spurs product and service innovation, corporate internal process digitalization, and changes in corporate organization and decision-making. Driven by digital consumption, industrial chain upgrade and restructuring and business mode innovations will improve user experience and firm efficiency, contributing to the quality, efficiency, and dynamism of the manufacturing industry. Amid surging digital consumption, the digital transition of manufacturing is still faced with some problems and challenges. It is important to deepen the user-centric concepts and modes of value creation, create a differentiated service system, optimize digital resource allocation, enhance digital brand management, and scale up R&D and innovation of products and services.*

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The digital economy is going gangbusters. With their extensive applications in the real economy, digital technologies have become new drivers of economic growth and market operations. Consumption of digital products and services, or "digital consumption" for short, has shown robust growth potential in China, contributing to consumption growth and presenting new opportunities to supply-side businesses. In this context, we should expedite industrial digitalization, improve industrial quality, efficiency and dynamism, and fully leverage the role of digital consumption in catalyzing product and business innovations, as well as in the improvement of internal processes, organizational structure, and industrial chains.

1. Implications and Characteristics of Digital Consumption

The rapid development of new-generation information technologies has engendered iterative

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innovations of business modes and transformed the ecosystem of consumption. Digital technologies such as internet, big data and cloud computing have been widely applied in everything from consumers' search for information, comparison and payment to logistical supply chains, manufacturing and new product development based on consumer psychology and demand generation. More and more digital elements have been embedded in products and services. Unlike traditional consumption, digital consumption derives from the digital elements and traits of products and services, which have transformed consumer habits, behaviors and lifestyles.

1.1 Heavy Dependence on Digital Technology Infrastructure

Technology is the bedrock of digital consumption. From marketing to platform development, branding and consumer services, every link is highly dependent on the digital technology infrastructure. Businesses create customer portraits and demand forecast models using digital marketing networks and data mining to tap into consumer demand. As an important channel linking supply with consumption, digital platforms not only address multitiered and diverse consumption demand, but help reduce supply-side costss and encourage R&D input. Concerning branding, digital consumption provides an immersive, experiential and interactive customer experience, allowing branding to be more targeted according to the size and purchasing power of various consumer groups. Concerning consumer service, digital consumption enables universal marketing through online and offline integration, supports professional services in various stages of consumption, and further improves consumer experience using third-party supervision and tracing.

1.2 Easier Consumer Demand Forecast

The data factor can be used as a tool to forecast and guide consumer demand. First, recommendation algorithms play a big role. Individualized push, search ranking and filtering algorithms address differentiated consumer demand for information and help businesses precisely match users with information. Second, digital immersion and interaction enable better consumer experience. Virtual reality (VR), for instance, allows consumers to experience and try products and services via shopping platforms for a more realistic and pleasing experience. In addition, some online platforms feature social network services and other interactive services to bring consumers in touch with other users who share similar hobbies. Third, digital technologies are consumer-centric and provide individualized services. Big data analysis and internet technologies match supply with differentiated consumer demand. Platform analysis allows businesses to evaluate supply chain capabilities, reduce inventory risks, and forecast consumer demand for the provision of more targeted products and services, contributing to a consumer-centric business mode with efficient decision-making.

1.3 Stronger Adaptivity and More Flexibility of New Business Modes

Not only has digitalization transformed consumption and the way products and services are delivered, but it has also led to the emergence of new business modes like online shopping, live commerce and digital culture, which represent a large share of the consumer market. Online and offline integration has created adaptive and flexible modes of digital consumption. Unlike traditional modes of consumption, digital consumers may choose their ways of shopping. Easier access to information gives businesses greater flexibility and convenience to improve quality, service and supply modes.

1.4 Quicker Consumer Feedback and Swift Response

The rapid development of internet applications has led to diversification in the channels and modes of consumption, and consumer feedback is pivotal for firms to improve service and become more competitive. In the context of digitalization, businesses may promptly obtain consumer feedback. Efficient after-sales service and low-cost online communication ensure a better consumer experience.

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Businesses may avail themselves of digital technologies to improve user experience, efficiency and cost-effectiveness. Data element analysis may reshape supply-demand links, allowing businesses to provide consumers with the right products and services based on user attributes and recommendation algorithms. User satisfaction and swifter response to meet customer expectations will sharpen product and service competitiveness.

1.5 Great Market Potential from Digital Consumption

Digital technology has penetrated every facet of life, giving rise to digital consumption potential. Data mining and resource processing allow firms to serve niche markets more effectively and address heterogeneous consumer needs in a fiercely competitive market. In the context of digital consumption, businesses are better positioned to offer targeted and differentiated products and services according to consumer attributes and behaviors to maximize market potential and create customer value. With its unique strengths, digital consumption has engendered more consumption channels and modes, prompting a shift from traditional brick-and-mortar stores to online shopping, from consumer search to pushed recommendations with images and videos and by influencers. This has stimulated consumption demand and increased consumption potential.

2. Current Status and Trends of China's Digital Consumption

New technology applications led by internet, cloud computing and artificial intelligence (AI) have proliferated in the consumer sector. Technology empowerment and consumption upgrade have spawned new business modes, use cases and services. With robust innovations, growth dynamism and adaptability, such emerging modes of digital consumption have become key drivers of consumption growth.

2.1 Rapid Growth in Digital Consumption

During the COVID-19 pandemic, new modes of digital consumption led by online shopping, video streaming, digital culture, and telemedicine have developed from strength to strength. Digital consumption as a share of total consumption has increased swiftly and become a key driver of China's economic growth.

By June 2022, China's internet users reached 1.05 billion, internet penetration rose to 74.4%, and access to mobile internet hit 99.6%.[1] Internet has become part of people's life. By December 2021, China's internet users spent an average of 28.5 hours online each week, up 2.3 hours from the previous year. The number of online shoppers has increased steadily. By December 2021, China's online shoppers reached 842 million, up 59.68 million, or 81.6% of all internet users. Online meal delivery and ride-hailing apps have registered the fastest growth of users, which numbered 544 million and 453 million, up 29.9% and 23.9% from the previous year, respectively.[2]

In 2021, China's online sales volume totaled 13.1 trillion yuan, up 14.1% from the previous year, and the online sales of physical goods accounted for 24.5% of total retail sales volume of consumer goods. E-commerce has played an increasingly positive role in digital consumption growth, bridging manufacturing with consumption, online with offline, cities with the countryside, and domestic market with overseas markets.

2.2 Digitalization Empowers Traditional Consumer Sectors

In promoting consumption and addressing differentiated consumer demand, a key step is to strengthen and invigorate traditional consumption by applying digital technologies. Traditional shopping

[1] China Internet Network Information Center (CNNIC). *50th Statistical Report on Internet Development in China*, http://www.cnnic.net.cn/n4/2022/0914/c88-10226.html.

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centers and commercial businesses have employed digital, IT and other mobile applications to create immersive, experiential, and interactive environments and new business modes like smart shops, smart restaurants, contactless delivery, and situation-based consumption as part of their intelligent renovations.

Judging by the four pillars of traditional consumption of home appliances, furniture, automobiles and catering, digital empowerment is expected to unleash greater potential. With the help of virtual reality (VR) technology, internet platforms provide consumers with an immersive shopping experience. This has greatly facilitated car buying, for instance. Online consumption of furniture and home appliances has become common. In addition to a wide range of choices, merchants provide consumers with door-to-door installation and after-sales services at the time convenient for consumers. Restaurants have collaborated with meal delivery, e-commerce and video streaming platforms to broaden online sales channels, situationize dining behaviors, strictly control the quality of food ingredients, deliver better consumer experience, and speed up the digital transition.

2.3 Extension of Digital Content Consumption

Driven by the tide of digital consumption, China has witnessed rapid development in online health services, online entertainment, online fitness, online tourism and other "Internet+ service" business modes, and consumer demand for digital services and products has increased steadily. Telemedicine, for instance, saw the fastest growth of users, which reached 298 million by December 2021, up 38.7% from the previous year. Cloud computing has enabled new ways of entertainment and consumption such as virtual travel, virtual exhibitions and virtual pets. Emerging sports activities like smart fitness, virtual events and virtual sports have found popularity among the public, who benefit from smarter fitness amenities.

During the COVID-19 pandemic, online queueing, live commerce and remote work have become a way of life. Big data analysis of consumer preferences has improved consumer experience. An increasing abundance of digital products and services has brought consumers a brand-new interactive experience unlike in traditional brick-and-mortar stores, offering dynamism for tapping into market potential and spurring consumption upgrades. New business modes, broader consumer coverage and impetus to urban and rural consumption upgrades stemming from digital consumption have underpinned China's digital transition.

2.4 Digital Consumption Potential Unleashed in Low-Tier Cities

Amid China's economic development and urbanization, low-tier markets have shown unprecedented consumption potential thanks to improving infrastructure and logistics and rising household disposable incomes. In the first half of 2022, China achieved the goal of "connecting every county to 5G internet" after having connected "every administrative village to broadband internet" in the previous year. By June 2022, China's rural netizens reached 293 million, and rural internet penetration stood at 58.8%.[3] Urban and rural internet penetration gap narrowed from 36.1% by the end of 2012 to 21.6%, representing a sharp decrease in the urban and rural "digital divide".

By the end of 2021, China's rural road length exceeded 4.46 million km, up 84,000 km from the end of the previous year. 82.2% of townships were connected to Grade 3 roads and above, up 1.4 percentage points. The number of rural parcel delivery service outlets increased by over 30%, and over 98% of townships were covered by parcel delivery services.[4] More than 1,300 counties were covered by e-commerce, and over 2,000 county-level e-commerce distribution and delivery centers were built. During 2014-2021, China's rural e-commerce sales volume jumped over tenfold from 180 billion yuan

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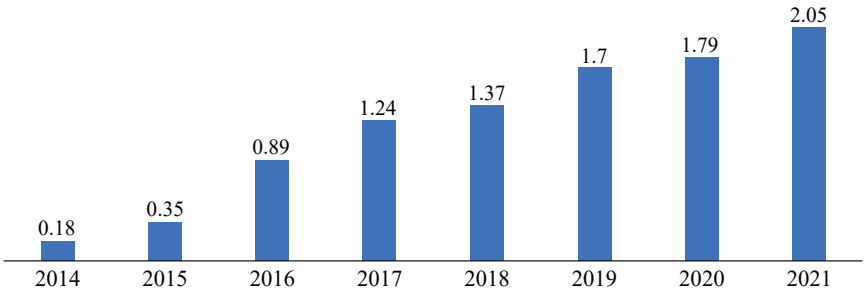

Figure 1: Rural E-Commerce Retail Sales Volume, 2014-2021 (in trillion yuan)

Source: The Ministry of Commerce.

to 2.05 trillion yuan, and its share in national e-commerce sales volume grew from 13.6% to 15.7%. The emergence of online education, telemedicine, video entertainment and other service consumption in the countryside has vastly enriched the cultural life of rural residents and spurred the extension of rural digital consumption from material to service consumption.

2.5 Growing Influence of Generation Z

Generation Z consumers refer to those born between 1995 and 2009 and grown up in the internet era. According to the National Bureau of Statistics (NBS), China's newborn population during 1995 and 2009 stood at some 260 million, accounting for 18.4% of its total population in 2021. Unlike other consumer groups, Generation Z consumers have the following distinctive consumer characteristics: First, they have a passion to consume and derive joy from consumption more than they do from the utility of the goods they purchase. Their consumption is driven by not just the satisfaction of needs but more importantly, the pursuit of lifestyle. Second, they attach great importance to the social networking dimension of consumption, which reinforces their self-awareness and identity unique to their social circle and gives them a sense of psychological resonance and belonging. Third, their consumption behaviors are more individualistic, distinctive, and diversified. They seek to demonstrate their personality by buying and consuming different products as part of their persona. Obsession with cultural diversity has led to the emergence of subcultures. "Subculture is mass culture" is a vivid reflection of such consumer psychology. Fourth, they put a greater premium on the cultural connotation and value proposition of commodities in making a buying decision and are willing to try new things and pay for the cultural value of products. As Generation Z consumers enter the workforce and climb up the career ladder, their consumption potential are increasingly unleashed. Generation Z consumers are digital natives, who not just contribute to the growth of digital consumption but upend the structure of the consumer market with their distinctive and diversified consumer behaviors.

In general, China's digital consumption is characterized by a large number and diverse backgrounds of consumers, refined new consumption modes, deepening consumption services, and improving infrastructure. Penetration of digital technology will be accompanied by a broader scope of consumers, rapid growth of market volume, and coordinated supply- and demand-side development. By taking part in product innovation and service design, users are heavily involved in creating brand value, contributing to growth potential for digital consumption and expediting digital applications in traditional industries.

3. Mechanism and Pathway for the Digital Transition of Manufacturing Driven by Digital Consumption

A new round of technological revolution and industrial change has not only created many fast-

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growing emerging technologies and industries but presented new opportunities for China's digital transition of manufacturing. Under the digital economy, digital consumption is extending in more directions with a strong demand-pulling effect. Data empowerment propels product and service innovations in the manufacturing industry to enhance user experience and firm efficiency and transform the quality, efficiency, and dynamism.

3.1 Propelling Digital Product and Service Innovations

Digital consumption has unleashed individual consumers' demand and market potential. Consumption of digital content as part of firms' value creation serves as an external impetus for industrial change and innovation. Rapid growth in digital consumption, retail network development and improving online payment systems have enabled and propelled digital product and service innovations. First, data element analysis can be used to tap into consumer demand. Modern information analytics based on big data and cloud computing helps manufacturers improve user experience and develop innovative products. Moreover, it takes a shorter time for firms to create value. With the help of digital applications, commercial value can be derived from each business process, allowing firms to maximize returns with cost reductions and boost product and service innovations. Third, digital consumer feedback may speed up firm innovation and R&D and cheapen the cost of collecting information.

3.2 Expediting Internal Business Process Digitalization

Digital consumption has turned individualized and differentiated demand from implicit to explicit with greater economic value and economies of scale. In facilitating the digital transition of all internal processes, firms apply digital technologies in R&D, design, manufacturing, processing, marketing and after-sales services. Integration of business processes is followed by business coordination throughout the value chain via whole-process data analysis for greater firm efficiency. In addition, process technology is the fundamental manifestation of overall manufacturing performance and competitiveness. Breaking free from barriers to digital process upgrades is conducive to creating a reliable supply system. Digital consumer behaviors and data analysis provide the direction and foundation for achieving breakthroughs in process technology. Digital applications facilitate process renovation, process optimization and high-quality product output. Digital tracing is a basic assurance that guides enterprise quality management, monitoring, inspection, operation and maintenance forecast.

3.3 Inducing Corporate Organizational Restructuring and Change of Decision-Making Model

Digital consumption is a bridge linking digital industries with industrial digitalization, as well as an important tool for fostering new-type consumption and spurring domestic demand. In the context of digitalization, the corporate organizational structure has evolved from the traditional pyramid structure to a more efficient management mode compatible with digital development. Organizational restructuring has changed the labyrinth hierarchy and complexity of traditional command chains, making it easier to transmit information in an efficient and truthful manner.

Digital thinking, skills and data management competencies at various management hierarchies help firms develop integrated digital management platforms, enable data-driven smart decision-making, and complete the digital transition. In combination with online and offline data resources, enterprises make strategic decisions with the help of digital analytics in line with future trends. Management decisions are made according to standards formulated with digital technology and subject to monitoring and evaluation to ensure targeted decision-making. By tailoring business decisions to digital consumers, companies are in a better position to tap into consumption potential and stay competitive.

3.4 Digital Consumption Propels Industrial Chain Upgrade and Restructuring

China's manufacturing industry is faced with daunting challenges and risks losing its traditional

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advantages. Diminishing demographic dividends and rising factor costs have presented obstacles to the traditional manufacturing industry. Technological advancement for critical links of the industrial chain has become vital for industrial transition and upgrade. Digital consumption creates an impetus for manufacturing enterprises to upgrade the value chain from R&D to sales and from internal equipment to operational management.

First, digital technology offers a tool for cost reduction. Big data and AI applications, for instance, have sharply cheapened the cost of intermediate products, creating dynamism for industrial and supply chain optimization and upgrades. Second, digital technology contributes to industrial chain digitalization. Digital applications may effectively improve the quality, stability and reliability of industrial products and meet individualized and differentiated consumer demand. Third, digital technology contributes to industrial and supply chain resiliency. Advanced digital applications have enhanced production line flexibility, allowing for adjustment to industrial and supply chains according to consumer demand. The result is faster firm response to market changes and efficient and low-cost industrial and supply chain operations. By bolstering domestic manufacturing competitiveness, digital technology keeps manufacturing enterprises from relocating elsewhere, builds upon the strength of traditional product exports, and supports enterprises in exploring international markets.

3.5 User Participation and Value Co-Creation Promote Business Mode Innovations

In the context of digitalization, business modes have shifted from product- and service-centric to user- and consumer-centric. Only those products and services that increase user participation and satisfaction will meet individualized and differentiated consumer demand. Consumer demand analysis with the help of digital tools may create new value for users and businesses. Instead of passively receiving products and services, consumers take an active part in the design and delivery of products and services, which gives them a sense of self-realization. Such a unique experience will greatly increase user stickiness. For manufacturers, user participation in the design, development and manufacturing of products and services to some extent helps bring down corporate operational costs. User participation and value co-creation contribute greatly to corporate competitiveness, openness and innovation. Such a business mode that reflects and meets consumer demand is more holistic and systemic. It is also harder for competitors to emulate and thus more competitive.

4. Challenges for Manufacturing Digitalization Driven by Digital Consumption

With the advent of the digital era, digital transition has become a natural choice for Chinese manufacturers to cope with the rising cost of production, ramp up innovation for better product and service quality, and jettison factor-driven growth and low-cost competition models. In the face of strong digital consumption growth, challenges exist in China’s manufacturing transition.

4.1 Lack of Digital Awareness and Top-down Design

Some traditional manufacturing enterprises are ill-informed about and underprepared for digital transition. Without a clear clue about consumer-centric innovation, they struggle to meet differentiated consumer demand in the digital era. The imminence and game-changing nature of the digital transition are not well understood. With an ostrich mentality, some manufacturing enterprises have refused to embrace digital transition and therefore lost market share. Another problem is the lack of adaptability. Traditional manufacturers often find it challenging to re-purpose their existing resources and innovation capabilities to develop products and services for the digital consumer market. Their slow response to an ever-changing market, coupled with supply-demand uncertainties, makes it hard for them to seize market opportunities. At the national level, despite the great importance attached to developing the digital economy and supporting manufacturing digitalization, the government has yet to identify clear

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goals, requirements, pathways, and implementation steps for digitalization. The lack of clarity about the future of digital transition makes it hard for manufacturing enterprises to make determined steps towardsdisruptive digitalization under a long-term plan with clear goals and directions. What is also missing from the scene is overall strategic planning and a clear approach for transition. In the absence of central coordination, various business systems operate in isolation and cannot share resources and information with each other. In addition, constant improvements should be made to the top-down design. The digital transition should move ahead along the path of the latest technological and market developments. There should be key requirements for the overall progress.

4.2 Manufacturing Industry Remains Ill-Prepared for Digital Transition and Ill-Equipped to Make the Most of Data

China's manufacturing enterprises are ill-prepared for digital transition despite its importance to competitiveness and business diversification. The first shortcoming is their ineptitude to identify digital market. In a fast-changing digital consumer market, those enterprises are incapable of capturing front-end consumer demand and seizing opportunities from new consumer concepts and diverse consumer demand. Second, manufacturing enterprises are clumsy when it comes to applying digital technologies. Long used to traditional business modes, those enterprises are less adaptive to digital applications for management and innovation. Besides, there is little experience and guidance to follow for digital technologies to be swiftly deployed across heterogenous manufacturing sectors. The third problem relates to inexperience to integrate digital information. Instead of being confined to only a few types of resources as in the past, traditional manufacturers have yet to develop capabilities to integrate digital information and extract useful information to stay competitive in the era of digital consumption.

What is also crucial to the digital transition is the data factor, which manufacturing enterprises must learn to use. China's data market is imperfect, and access to such information as data rights and prices is incomplete, creating obstacles to data applications. Another problem is the lack of awareness to make use of data, which is vital to tapping into consumer market potential. Chinese manufacturing enterprises are ill-informed about the value of data and ill-equipped to use data in creating products and services. Their use of data remains insufficient for adapting to heterogenous consumer traits and steering the course of digital transition and upgrade.

4.3 Imperfect Support System for Industrial Digitalization

For traditional enterprises, digital transition entails all-round development throughout the industrial chain to raise the level of digitalization in each link and bring about an improvement of total factor productivity (TFP). Concerning R&D, the lack of consumer data empowerment makes it hard for R&D to move in the correct direction, resulting in a loss of market opportunities. Intelligent and digital applications are essential to improving the traditional manufacturing process, which is important to address the overcapacity of medium- and low-end products and quality gaps. Closed internal processes present grave challenges to business operation and management. In pursuing the digital transition of manufacturing, businesses should beef up their competence to integrate whole-process data and information, speed up digital office, and smart monitoring, among other applications.

The digital transition is underfunded for most firms. First, firms have yet to plan for the financial input for whole-process digital transition and develop a clear-eyed view of overall costs. Second, special government funds are granted on an ex-post basis and too sporadic to concentrate fiscal resources to accomplish major undertakings, nor have such funds catalyzed private investment. Finally, the long investment cycle means a lack of return in the short run, which makes firms hesitate to invest in the digital transition.

4.4 Talent Shortage for Industrial Digitalization

Shortage of digital talent has become a common problem facing the digital transition of many

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sectors. Knowledge about information technology is far from enough. What businesses need the most are cross-disciplinary professionals with insights into industrial reality and able to think outside the box. The talent shortage facing China's manufacturing industry in its digital transition is threefold: First, there is a talent mismatch for the digital transition of manufacturing. The multitude of manufacturing sectors with distinctive characteristics and different goals and methods of transition require a diverse range of professionals to complete the digital transition for each sector, but the problem is that such professionals are in short supply. Another problem is the exorbitant cost of digital talent cultivation. Most manufacturing enterprises must choose from digital professionals without industry experience and experienced industry experts without a knack for digital technology. Either way, talent cultivation is costly for enterprises. The risk of job hopping has also deterred enterprises from investing in human capital. Third, manufacturing enterprises are run by industry insiders who know little about digital technology and thus cannot come up with a suitable plan for digital transition. Fourth, digital talent cultivation involves a long cycle. When partnering with universities for joint education programs, businesses should consider the long cycle of educating digital professionals with the right skills.

5. Countermeasures and Policy Recommendations for Promoting Digital Consumption and the Digital Transition of Manufacturing

The nature of the digital transition is to create new value for users. Digital consumption steers the course of product and business innovations by forcing enterprises to make the most of data to perceive changes in demand and engender new business modes. In propelling industrial digitalization, businesses should deepen the user-centric concept and value creation mode and elevate product and service R&D and innovation through whole-process smart digital upgrades.

5.1 Enhancing New Product R&D with Digital Technology Empowerment

Manufacturing enterprises should employ digital applications to enhance digital R&D, develop more competitive products and services, and increase brand influence. The priority is to increase the number of innovative products. Manufacturing enterprises should explore the value of data to precisely identify consumer demand and employ digital technologies for new product development. Vigorous support should be extended to coordinated industrial chain innovation, intellectual property service platform development, and smart product development and application. Second, progress should be made in digital R&D. The government should expedite information coordination across digital industrial chains, encourage the indigenous development of innovative products, establish a database of creative elements and digital resources, promote new business modes such as coordinated innovation and user participation, and set up a public service platform for digital design to support the efficient use of digital resources. Third, businesses should reshape the mode of product development and manufacturing. Production- and consumption-side data resources should be integrated to link supply with demand. Under the innovative mode of collaborative manufacturing, businesses should tap into differentiated consumer demand, create a consumption-driven organizational mode, and explore new modes of individualized production and supply for digital technology to empower product and service consumption. Fourth, businesses should promote integrated green product design and manufacturing, develop green products with the support of digital technology, increase the supply of green products, and develop "Internet+" and "smart+" recycling and shared service modes.

5.2 Digital and Intelligent Upgrades to Improve Quality and Stay Competitive

Digital consumption will drive the digital and smart transition and upgrade, contributing to better quality, performance, and user experience. The priority is to step up digital renovations. Businesses should be guided to digitalize their full business cycle from R&D to manufacturing, business

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operation and management and market services, expedite intelligent upgrade and application of critical technologies, and enhance digital management by accessing cloud platforms for a swift digital transition. Second, businesses should develop a digital tracing system. Where applicable, they should employ digital technology for a quality tracing system encompassing various links from the supply of raw materials to product manufacturing, consumption and marketing. They should make full use of tracing data, provide smart monitoring and operational maintenance, and improve product quality to increase user stickiness, public recognition and consumer confidence. Third, businesses should deepen smart supply chain management. Specifically, they should accelerate the deployment of digital technology and equipment, integrate and share data in critical processes, and develop smart supply chain service platforms as part of their overall supply chain management system.

5.3 Strengthening Digital Brand Management for Integrated Design and Brand Development

Businesses should enhance data resource management and analysis, improve management procedures, and make synchronous progress in manufacturing, R&D and brand promotion to beef up brand influence and international competitiveness. First, they should leverage digital technology in brand development. Product design, cultural creativity and technological development should be embedded in brand development to explore the cultural value of brands. Second, digital marketing. Data factor should be fully utilized to create consumer portraits and demand forecasts and develop new brands that spearhead stylish consumption. Businesses should be guided to develop smart stores with diversified consumption occasions to meet various consumer demand, achieve precise brand orientation, and raise brand awareness and social value. Third, the government should increase the supply of public services for digital transition and create a favorable environment for brand building. Digital technology should be employed to assist brand development, improve brand management procedures, and realize online and offline coordination. Businesses can rely on cross-border e-commerce to increase their brand influence and explore market diversification. Fourth, digital marketing tools should be employed to increase brand influence and highlight distinctive strengths to promote brands with influence and product value-added.

5.4 Creating a Differentiated Service System to Assist Manufacturing Digital Transition

High-quality development cannot be achieved without digital empowerment of manufacturing products and services. Businesses should take the initiative to digitalize, explore the value of data resources, and meet differentiated consumer demand. First, they should make the most of the data factor. Data should be combined with product and service innovations to speed up data processing capabilities, achieve data interoperability throughout all processes, and identify and address user demand based on digitally collected information. Second, businesses should improve the level of digitalization across various links of their products and services. From product promotion to business transactions, they should enhance digital service concept, allow users to take part in R&D to increase their self-esteem, and establish social networking communities to increase user stickiness. It is also important to digitalize business transactions and broaden online after-sales channels to enhance user experience while addressing differentiated service needs. Third, businesses should develop safe and efficient service modes such as security management mechanisms for intelligent risk monitoring. Digital transition will bring consumers closer to the brand by letting them experience services for win-win cooperation, reduce corporate operational cost, and offer targeted services based on individualized attributes. Fourth, businesses should reward consumers for their feedbacks. Consumer demand and after-sales feedback data are key information for product and service innovations. Encouraging consumers to report their experience and demand will increase their sense of gain and user stickiness.

5.5 Improving Top-down Design and Digital Resource Allocation

A clear-cut development path is of vital importance to corporate digital transition. First, businesses

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should establish a top-down design program for digital transition to communicate the goals, pathways and implementation steps to all staff. They should establish a complete system for talent recruitment, evaluation and improvement to foster digital professionals. Second, the government should focus its investment on core industries for digital transition to foster exemplary enterprises for digital transition. Third, the government should encourage enterprises to access cloud computing, apply information technologies, and concentrate corporate resources on cloud platforms. This will help improve productivity, managerial efficiency, business coordination and resource allocation to support data-driven new ecosystems. Fourth, businesses should implement digital transition in various links of the supply chain and integrate data, innovation, and industries throughout upstream and downstream supply chains. Moreover, they should fully access digital R&D resources from research institutions, universities and professional institutions and support the development of key laboratories and innovation platforms in the digital economy domain. Investment should be made in critical digital industries and bring about breakthroughs in key technologies.

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