数字经济时代产业融合赋能制造业高质量发展

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摘 要：本文旨在探讨数字经济时代产业融合的新发展特征，考察产业融合推动制造业高质量发展的表现形态、存在的障碍与大国路径，并提出对应性的政策建议。具体而言，数字经济时代产业融合的核心资源是数据要素，第一动力是创新驱动，根本理念是用户思维，实施主体是平台企业，重要支撑是富饶生态。产业融合契合新发展理念，实现从后发优势、比较优势走向竞争优势，并加快供给侧结构性改革与推动需求侧升级，从而实现制造业高质量发展。未来，产业融合推动制造业高质量发展存在五条差异化的路径，分别是推动先进制造业与现代服务业深度融合发展，产业链一体化融合发展，数字经济与实体经济融合发展，一二三产业融合发展，以产城融合、城乡融合、区域融合推动产业融合发展。

关键词：产业融合 制造业 数字经济 高质量发展

JEL 分类号：L16, L80, E61

一、引言

制造业是立国之本、强国之基，是国民经济的支柱产业，是生产能力、创新能力、竞争能力和综合国力的重要体现和物质载体。因此，制造业高质量发展是宏观经济行稳致远的重要压舱石，具有极其重要的战略性、全局性意义。习近平总书记强调，“加快建设制造强国，加快发展先进制造业，推动互联网、大数据、人工智能和实体经济深度融合”（习近平，2021），这也为中国制造业高质量发展指明了发展方向。中国拥有完备的制造业门类和超大规模市场，成为推动制造业高质量发展并参与国际竞争的重要基础。近年来，制造业高质量发展的内生动力稳步提升，持续向全球价值链的中高端攀升，展现出良好的发展韧性。

改革开放以来的经验证据表明，制造业的发展离不开产业分工所带来的分工效率，并在产业分工中通过嵌入比较优势环节，实现“从小到大”的历史性转变。目前，从产业分工走向产业融合的新发展阶段，生产力与生产关系共同演化，成为数字经济时代推动制造业“由大变强”高质量发展的

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重要途径。建立在高度专业化分工的优势基础上，产业融合能够重新组合原有的分工链条，通过将部分社会化分工转移为企业内分工，在保留分工效率的基础上降低产业链断裂风险和交易成本，提高生产经营效率，使得已有产业边界逐渐模糊或消融，并在原有产业边界处融合发展成为新的产业形态，形成制造业高质量发展的增长源泉。另外，产业分工已经从产业间走向产业内并进一步演化到产品内分工，精细化的分工水平极大程度上提高了制造业生产效率，人们愈发能够享受“物美价廉”的工业化产品；可是，看似美好的事情也有“代价”，主要表现在生产端失去了多样化，从而只能满足消费需求的共性特征，很难兼顾消费需求的个性化特征。数字经济时代，通过产业融合发展，尤其是数字产业与传统产业的融合共促，企业能够有效地收集个性化的消费数据，推动制造端的定制化生产，从而满足用户的个性化需求。产业融合成为推动制造业系统性变革、走高质量发展的重要途径。因此，有必要对数字经济时代产业融合的特征进行总结，考察产业融合推动制造业高质量发展的表现形态，进一步提出产业融合视角下制造业高质量发展的大国路径，以期获得应对性的政策建议。

二、数字经济时代产业融合的新特征

（一）数据要素是产业融合的核心资源

在数字经济时代之前的发展模式下，核心要素在于劳动、资本和技术。数字经济时代数据要素处于核心位置，作为全新的要素深度参与生产。数据要素并非孤立，而是充分与其他要素相融合，发挥数据要素“放大、叠加、倍增”的特性。因此，产业融合的微观构成是要素层面数据与其他要素的融合，融合的核心也在于数据要素发挥广泛的赋能效应。

归结起来，数据要素在两个方面推动产业融合发展：一是数据要素使得生产过程变得更加自动化、智能化、智慧化，愈发能够以较低成本生产出多样化的产品，从而满足个性化的需求；二是数据要素使得供给与需求无缝对接，消除生产者和消费者之间的信息不对称，产品能够精准及时送达到用户。因此，在数据要素加持下，不同产业融合发展尤其是传统产业与数据产业的融合发展呈现出良好发展势头，带来传统产业发展理念、经营模式、产业形态的根本性重塑（任保平，2023）。例如，酷特智能[①]作为一家服装定制企业，充分依靠庞大用户消费数据赋能服装版型设计环节的重塑，通过智能高效的匹配工作替代传统的版型设计师费时费力的设计工作。因此，数据要素成为产业融合的核心战略性资源。

[①] 酷特智能从传统的服装定制走向智能化定制服务，并逐渐向打造C2M产业互联网平台生态、提供智能制造个性化定制解决方案和数字化治理提供商转型，是数字经济时代产业融合的典型案例。

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（二）创新驱动是产业融合的第一动力

哪些产业存在融合的技术基础，哪些产业存在融合的市场需求，如何运用既有的技术手段推动产业融合发展，都离不开创新驱动作为第一动力的支撑。例如，智能手机不再单纯地表现为手机制造业，而是“智能+手机”融合的综合体，除了组成手机的硬件设施，还需要操作系统、应用软件以及内容服务予以配套，智能手机才能搭载诸多的应用场景并提供丰富多彩的内容服务。对于传统文化产业而言，随着文化与科技的融合，智能化呈现与再现手段推陈出新，文化已经不再是传统意义上的服务业，而是需要现代工业的支持与融合。据统计，电影《流浪地球》和《流浪地球2》的票房分别为46.87亿元、40.29亿元，位列中国电影史累计票房的第5名、第10名[②]。高票房高口碑的背后，需要成熟的电影工业才能付诸实践，前期影视虚拟化制作平台进行虚拟拍摄、人工智能实现面部增龄减龄效果等特效呈现、先进工业体系提供实景科技道具，“人工智能+电影+工业”的融合发展带来电影工业的创新发展，以人们喜闻乐见的形式展示出文化魅力。再如，汽车与互联网的融合，从传统的汽车产业演变为现代化的智能汽车，从关注运输、驾驶体验走向人机互动、丰富场景，创新驱动赋予原本已经非常成熟行业全新的发展活力，重新定义产业发展态势和发展趋势。

（三）用户思维是产业融合的根本理念

“人民对美好生活的向往，就是我们的奋斗目标”（习近平，2023）。美好生活的定义并不是千篇一律、一成不变的，而是存在历史性和时代性。目前，建立在社会生产力得到极大解放、物质文明得到极大改善的条件下，对制造业提出更高的发展要求，那就是更大程度上满足消费者的需求。用户思维构成产业融合的根本理念，通过产业融合满足用户异质性、多样性和个性化的需求。尤其直接面对消费者的轻工业领域，更需要用户思维和用户导向，因人而异提供商品与服务。酷特智能在服装个性化智能定制领域持续探索，利用智能工具便捷收集用户个性化需求的相关参数，然后通过版型大数据进行综合对比，在高效的数据流动过程中实现人机互动、供需匹配，从而充分考虑用户需求的差异性特征，利用大数据和智能化手段实现服装的智能化定制，通过技术融合和产业融合实现个性化需求的满足。

总之，产业融合能够满足用户的三重需求。一是通过产业融合满足复合需求。文旅融合建立在文化产业与旅游产业两大产业的基础上，复合了多种其他产业形态，实现一体化发展；更进一步，农文旅就是在原有融合的基础上继续融合特色农元素。二是通过产业融合满足个性化需求。随着数字经济的发展，对各行各业都产生极大的重塑力量，使得个性化需求和定制化生产成为经济意义上的可能；数据与购物的融合创造个性化的购物体验，智能化差异性推送与传统行业的融合，满足了用

[②] 资料来源：猫眼影片票房总榜，https://piaofang.maoyan.com/mdb/rank。

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户的个性化需求。第三，最高层面产业融合是创造用户需求。对于消费者来说，在某一项全新的商品（服务）出现之前，消费者可能并不能准确表达自己的需求。例如，从功能机向智能机转变的前夜，人们对通讯工具的需求停留在及时稳定的信息交流；随着智能手机的蓬勃发展，前所未有的需求才被激发出来，通过产业融合创造出了全新的需求类型。

（四）平台企业是产业融合的实施主体

传统产业融合表现为产业层面的系统性融合，往往是两个甚至多个具有共性特征的产业形成的产业融合，最为典型的是电信、广播电视和出版等部门在数字融合的基础上实现产业融合（周振华，2003）。数字经济时代，产业融合表现为平台企业是主体。平台企业具有跨界融合的特征，通过触网融合连接平台的两端，从而形成“哑铃状”的结构。工业互联网领域表现得尤为突出。中国具有影响力的工业互联网平台超过240家[③]，由此带来融合应用持续涌现。平台企业之所以能够成为产业融合的实施主体，主要是因为平台企业在长时间的经营过程中积累了庞大的用户数据，数据要素集中于平台企业并且成为最为重要的资产，从而具备跨界融合发展的条件。譬如，卡奥斯、酷特智能等细分领域的平台，都是从传统领域走向跨界融合发展的新航道，在分析用户需求的基础上持续引领行业发展技术范式的演化。同时，平台企业能够更好地协调产业链之间的各项资源，附属于平台之中的参与者与平台企业之间构成互利共生的协作关系。因此，平台企业凭借强大的市场控制能力和产业链优势地位，有效协调平台上下游企业，推动所有参与者面向融合方向有效推进。

（五）富饶生态是产业融合的重要支撑

传统产业融合相对来说比较简单，更多表现为技术融合和业务融合，产业融合并没有改变传统产业的本质逻辑。例如三网融合的基础是不同网络技术，从本质上看都是信息传输的通道，融合并没有改变这些产业发展的技术路线，更没有形成复杂的产业生态。数字经济时代的产业融合变得更加复杂，涉及数字经济、融合前产业A、融合前产业B甚至更多其他产业，在数字经济的赋能下产业相互碰撞、融合、衍生，大大拓宽产业范围、模糊产业边界、催生全新的业态模式，产业融合的参与者、企业群落、竞合关系、外部环境变得更加复杂，演化形成富饶的产业生态系统。

首先，参与主体更加丰富，产业融合的主体有平台企业、支撑性企业和应用型企业，在生态系统中分布于不同的位置。其次，企业群落关系也成为鲜明特征，主体之间形成了哑铃状结构，处于哑铃两端的分别是上游支撑性产业（企业）群落和发展下游应用性产业（企业）群落，处于中间位置的是平台企业。再次，主体之间处于互利共生的关系，形成以用户需求为目标导向的生态系统，大量企业为了满足用户特定需求而有序分工、协作生产。最后，外部环境变得更加复杂。以前，企业依靠比

[③] 资料来源：第52次《中国互联网络发展状况统计报告》，https://www.cnnic.net.cn/n4/2023/0828/c88-10829.html。

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较优势可以获得相应的市场；而数字经济时代，企业需要具备独特的竞争优势才能嵌入到生态系统，竞争关系从企业上升到生态系统，企业需要与生态系统同呼吸、共命运，竞争失败的代价是整个生态系统的衰败，甚至是系统性地退出市场。

三、产业融合推动制造业高质量发展的表现形态

（一）产业融合契合新发展理念是制造业高质量发展的基本内涵与识别维度

新发展理念是指创新、协调、绿色、开放、共享的发展理念，是中国经济发展迈入新常态、推动经济高质量发展的重大战略，更是关乎我国发展全局的深刻变革。因此，制造业高质量发展的基本内涵与识别维度，就在于制造业的发展满足创新、协调、绿色、开放、共享等特征。产业融合发展契合新发展理念，以科技创新为主要驱动、以协调为内在要求、以绿色为核心导向、以开放为必由之路、以共享为根本目的，从而实现制造业高质量发展。

首先，正如同数字经济时代产业融合的新特征，创新驱动是产业融合发展的第一动力，融合的过程也会催生诸多创新，带来5G、大数据、云计算、互联网等技术创新蓬勃发展，推动已有业态模式的创新，进一步推动制度、监管等层面的革新。其次，产业融合能够带来资源要素的优化重组，尤其能够推动数据要素、数字技术与传统要素的深入融合发展，提升要素的匹配度和利用效率，进而实现产业内部和产业之间更为协调的发展，并在技术演化下实现产业升级的动态过程。再次，产业融合发展能够有效降低共性技术的重复投入，典型的就是三网融合的案例，能够将三套网络整合成一套具有更强包容性的网络，从而有效降低重复建设与成本投入，实现更为绿色低碳的高质量发展。然后，产业融合促进开放发展，产业融合发展有利于汇聚开放条件下的多种资源，尤其是全球创新资源的集聚，进而实现竞争优势的提升。一方面是产业链与产业生态的开放，形成更为有效的要素组合与生产模式，另一方面是在全球开放的条件下实现全球价值链的攀升。最后，产业融合具有共享经济的特征，融合就是共享的内在特征，而共享是融合的实质所在，例如，无论是消费互联网还是工业互联网，他们既是融合发展的产物，也是一种“准公共物品”，具有鲜明的共享特征，为制造业高质量发展提供保障。

（二）产业融合实现从后发优势、比较优势向竞争优势的转变，引领制造业高质量发展

从改革开放到迈入新时代，中国无论是制造业规模还是体量上都实现质的飞跃，已经成为全球制造业大国，“仅用几十年时间就走完发达国家几百年走过的工业化历程”[④]。这一发展阶段，中

[④] 资料来源：《中共中央关于党的百年奋斗重大成就和历史经验的决议》，人民出版社，2021。

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国凭借体制机制改革释放活力、大量熟练劳动力释放动力、超大规模市场释放潜力，建立在后发优势的基础上积极推动改革开放，在开放竞争的环境中通过比较优势参与国际产业链分工。未来，制造业很难再有如此大规模“低垂的果实”。中国制造业已经进入从跟跑向并跑、甚至领跑转变的新发展阶段，例如高铁、特高压、光伏等领域。中国已经成为诸多制造业领域的全球领跑者，在这个系统性转变的过程中，产业融合起到核心作用。

第一，产业融合能够充分运用完整制造业门类和超大规模市场优势，在技术前沿面实现技术整合，在融合过程中凭借超大规模市场寻找特定市场，实现产业融合的“供”与“需”的耦合。完整的制造业门类为产业融合提供了产业基石，产业之间的碰撞、演化、融合都能够找到相应的技术支持和要素支撑；超大规模市场更是为产业融合提供庞大的消费基础和产品市场。根据第52次《中国互联网络发展状况统计报告》统计数据，截至2023年6月，我国网民数量达到10.79亿人[⑤]。因此，任何一种融合的业态和应用很容易做到千万用户甚至是数亿用户级别。

第二，产业融合能够充分运用数据要素、数字技术的优势因素，持续推动融合成本的下降，尤其是建立在网络外部性条件下，将会出现赢者通吃的马太效应，从而获取较大份额的市场规模，进而通过产业融合发展实现竞争优势；数字经济时代，产业融合发展带来一系列全新的产业形态、商业模式、细分市场，创造全新的应用场景和消费场景。因此，依靠比较优势和规模经济的老路子愈发没有市场，企业愈发需要在小切口的市场之中寻找机遇，从而实现竞争优势的顺利提升。数字经济时代产业融合的两种影响并非孤立存在，而是相互影响，共同推动产业融合发展，并推动制造业从后发优势、比较优势向竞争优势的历史转变，实现制造业高质量发展。

（三）产业融合加快供给侧结构性改革，直接推动制造业高质量发展

“供给侧结构性改革，重点是解放和发展社会生产力，用改革的办法推进结构调整，减少无效和低端供给，扩大有效和中高端供给”（中共中央文献研究室，2017）。产业融合正是从这些方面入手，实现供给侧结构性改革。

从企业层面看，企业寻找能够产生最大价值并匹配现有商业模式的业务模块，以实现价值创造和捕获的一致性，因此会跨越职能和组织边界，推动企业业务之间的渗透、互补和交叉。同时，企业技术创新步伐持续加快，企业通过结合其他市场的产品或服务特征来扩大其产品或服务的范围，最终导致产业融合。以共同技术为基础的相关产业会逐渐收缩产业边界，企业为了能更好地适应市场的需求，促使企业不断地沿着现有技术曲线丰富业务线，并为产业发展带来新的产品或商业模式等。

从产业层面看，产业融合有助于加速现有产业结构重组的进程，导致全新的产业业态和经营

[⑤] 资料来源：第52次《中国互联网络发展状况统计报告》，https://www.cnnic.net.cn/n4/2023/0828/c88-10829.html。

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模式持续涌现，通过价值主张、技术和市场等要素融合以模糊行业间的边界（胡汉辉、邢华，2003）。这种调整实现产业结构的系统性优化，带来供给端全要素生产率的提升，并扩大社会的有效供给水平，主要表现为两个方面：一是产业融合能够推动传统制造业充分吸收先进技术和发展理念，借鉴其他产业的优势因素实现融合发展，带来产业的转型发展、创新发展与数字化转型，从总量上持续减少产业体系中传统制造业的比重；二是产业融合更能够催生一系列全新的产业业态，培育先进制造业、高端制造业的未来形态，例如，工业医生的出现就是传统的医疗行业在工业领域的充分运用而创造全新的产业形态，是制造业高质量发展的重要增长极。

（四）产业融合推动需求侧升级，倒逼制造业高质量发展

产业融合从表象上看是产业之间的融合，属于生产端的范畴。但是，融合的根本理念是用户思维，通过融合创造更好的产品与服务并满足用户需求。用户需要的不再是产品本身所有权的转移，而是产品所能提供的效用，甚至是不同产品功能的组合，这就迫使企业跨越已有的产业边界，向相关业务领域拓展，以谋求更为稳固的市场势力。行业界限的模糊并非行业随着时间的推移变得相似；相反，这预示着两个先前独立实体之间的整合和交叉的激增，因此需求的不断升级促使产业融合的不断发展。尤其是数字经济时代，产业融合具有全新的特征，新一代信息技术加速涌现全新的模式、业态和场景，其实是通过融合发展创造令人惊喜的全新需求，从而满足人民对美好生活的向往。例如，在功能手机时代，人们需要手机主要是为了实现适时的信息沟通功能，智能手机本质上是多种技术、复合功能的充分融合，开发出一系列衍生的产业业态与全新的需求，带来全新的用户体验。产业融合带来需求侧升级，进而倒逼着制造业走高质量发展的路子。

四、产业融合推动制造业高质量发展存在的障碍分析

数字经济时代，产业融合推动制造业高质量发展仍处于发展阶段，仍然存在诸多资源配置、技术提升、区域协同、人才队伍、营商环境等方面障碍与问题，归结起来表现为两大方面：产业融合推动制造业“破旧”力度不够、产业融合推动制造业“立新”能量不足。

（一）产业融合推动制造业“破旧”力度不够

随着产业数字化发展，制造业广泛依托数字经济实现触网发展。但是，制造业仍处于从规模化生产阶段向个性化定制阶段的转型过程，服务要素在投入与产出中的占比较低，服务业对制造业延伸、渗透、融合不足，制造业服务化转型有待突破，通过产业融合发展推动制造业变革制造流程、重塑价值链条、创新业态模式仍显不足，这就导致企业生产无法完全实现多样化产品与异质性用户需求的精准匹配，难以达成个性化服务与个性化定制的精准对接，难以使客户产生高水平的用户体

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验。因此，推动制造业破旧力度不够，尚未完成“数字+制造+服务”全链条、全生态、全生命周期管理的转型（杨蕙馨、孙芹，2023）。

另外，制造业内紧密关联产业、产业链上下游企业的重组融合不足，产业链上下游企业之间、相关产业之间尚未实现互联互通，重组型融合受到约束。制造业企业不能根据客户需求与内外环境的变化实时优化制造资源，尚未实现信息资源的综合集成，使得企业在增加服务要素过程中无法实现有的放矢，制造业与服务业融合障碍较多。究其原因，产业融合的赋能作用并没有完全得到释放，数据要素仍然不能实现开放共享流动，海量的数据资源仍缺乏有效地整合与联通，数据的开放、共享与应用程度远远不够，社会价值未能得到充分挖掘与利用。

（二）产业融合推动制造业“立新”能量不足

建立在数字产业化持续发展、战略性新兴产业和未来产业持续涌现的背景下，产业融合推动制造业立新能量不足，主要体现在技术、企业和产业三个层面。

从技术层面看，制造业还没有大规模依托互联网、物联网技术实现跨界融合发展与产业衍生创新，具有创新性的技术在制造业中的应用并不广泛，数字经济创新发展带来的大数据、云计算等新技术手段在制造业中尚未实现大规模普及。信息技术等高新技术对制造环节的渗透深度与广度仍不够，没有完全打通网络、设备、系统、数据之间的壁垒，未实现信息的互联互通与综合集成，新一代信息技术与制造业尚未深度融合。

从企业层面看，制造业企业基于客户需求的数字化快速定制能力并不具备，并没有深入将互联网的优势运用到制造全过程，企业仍需借助规模庞大、巨额投入的渠道建设，实现对客户需求的实时感知与响应服务。

从产业层面看，制造业企业之间以简单的“竞争”与“合作”关联为主，以“共生”为关联的深层次产业融合状态有待形成，因此，如何充分运用信息融合与技术融合，推动产业边界模糊化与资源配置效率的提升，催生制造业高质量发展的新业态新模式持续涌现，成为利用产业融合推动制造业“立新”的关键点。

五、产业融合推动制造业高质量发展的大国路径

数字经济时代，产业融合推动制造业高质量发展需要分类治理、有序推进，以不同的目标导向和战略安排，推动先进制造业与现代服务业深度融合发展，产业链一体化融合发展，数字经济与实体经济融合发展，一二三产业融合发展，以产城融合、城乡融合、区域融合推动产业融合发展。

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（一）以增强制造业核心竞争力为根本，推动先进制造业与现代服务业深度融合发展

先进制造业和现代服务业深度融合发展，不仅是新一轮科技革命的必然结果，也是制造业高质量发展的重要途径，带来新业态、新模式、新路径层出不穷。具体而言，先进制造业和现代服务业深度融合发展存在两种路径，分别是服务型制造和服务衍生制造。其中，服务型制造的概念内涵等同于制造业服务化，主要是从制造端出发，以制造为主推动制造业充分融合现代服务业的发展路径；服务衍生制造则恰恰相反，以服务为主并且从服务端出发，往往是以平台企业为中心，凭借长时间经营过程中所累积的用户数据、消费习惯等大数据资源，不断向制造端融合发展。

具体从产业类型看，需要抓住制造业的核心产业，推动原材料工业、消费品工业、装备制造业、汽车制造等与服务业的全方位、全链条融合发展，健全制造业产业链的核心在于产业链的上游和下游，大力推动延链补链强链。加快制造业技术创新，实现辅助设计、系统仿真等工业软件国产化，推动制造工艺和制造设计的智能化、专业化。对于轻工业而言，需要着重打造“产品+内容+生态”的现代服务体系；对于重工业而言，则需要在“工业互联网+专业服务”领域发力。加快推动制造业下游的配套服务绿色化、智能化、品牌化发展，以优质的服务和理念打造制造业新的增长极。同时，还需要抓住服务业的核心产业，尤其需要抓住互联网、现代物流、研发设计、消费服务、金融服务等现代服务业的重要支撑作用，实现制造业与高端服务业的多维度融合。

（二）以增强产业链供应链安全稳定为基本要件，推动产业链一体化融合发展

全球产业链供应链原本是一种准公共物品，应该在国际分工的基础上，遵循互利互惠的原则持续维护并提升全球产业链供应链的韧性和安全水平。当前，全球产业链供应链、尤其是战略性新兴领域面临以美国为首的发达国家的制约，全球产业链供应链出现了断链的巨大风险，对产业可持续发展带来较大的风险因素。于中国而言，保障产业链供应链稳定是求生存谋发展的基本要件。因此，推动产业链一体化融合发展，不仅能够增强产业链供应链的安全稳定水平，还是制造业高质量发展的内在需要。

产业链一体化融合发展的实施主体在于平台企业，亦即产业链链主企业。例如，华为持续推动构建绿色低碳、可持续发展的产业链，在智能汽车领域主攻智能汽车芯片和操作系统，其中芯片有麒麟车机芯片、昇腾芯片等，操作系统有鸿蒙座舱操作系统、智能驾驶操作系统和智能车控操作系统等。围绕智能手机产业链，华为聚焦芯片和操作系统两大核心，推动自主的麒麟芯片，鸿蒙手机OS，在此基础上不断整合国内产业链，推动手机屏幕、射频、滤波器、光学镜头元器件、声学零部件、电池模块等硬件供应链体系建设，加快软件应用、内容服务等软生态建设。因此，需要充分利用产业链链主企业所形成的产业链供应链优势基础，发挥在引领产业链演进方向、技术路线和

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发展理念上的作用，持续推动产业链一体化融合。当然，产业链一体化融合也离不开海量的配套企业，提供大量辅助性、支撑性的应用及内容。最后，产业链一体化融合还需要考虑“流”的融合，主要表现在物流、信息流、资金流、人才流的相互融合。

（三）瞄准产业发展趋势和未来潜力，推动数字经济与实体经济融合发展

数字经济的发展离不开实体经济的支撑，而实体经济尤其是制造业的高质量发展更离不开数字经济的赋能。当前，数字经济从辅助性的角色转变为经济发展的主战场，也是大国竞争和大国发展的重要领域。推动“数实”融合发展的关键在于三个方面。

其一，数据要素赋能实体经济发展。中央层面已经多次确立了数据作为生产要素的地位，如何实现数据要素的商业化，这是数字经济与实体经济融合发展的重要方面。这需要解决三个基本问题，数据安全、数据产权、数据定价。就目前发展看来，制造业企业基于自身经营所积累的生产大数据利用得很好，主要是因为数据资源为企业所有，不涉及安全问题和产权问题，同时企业内部所产生的数据，也不需要对数据要素进行定价。问题较多的是用户层面的数据以及各级政府层面所沉淀下来的数据如何赋能实体经济发展。其中，用户层面的数据面临数据安全及用户隐私等方面的安全担忧，这些尚在解决的范畴之内。例如，通过“隐私计算”[⑥]让数据“可用不可见”不失为一种创新的探索，较难的是如何对用户数据的产权问题进行界定，这仍需要理论和实践层面的推进。政府层面的数据又分为两种情况：第一种情况是政府信息公开，这方面呈现出的是社会价值，有效监督政府行为；第二种情况是政府数据开放，对于各级政府及相应部门所积累的天气、交通、医疗等大数据资源，具有很大的经济效益，如何保障数据安全的前提下进行产权认定与数据定价，也是需要积极探索的研究领域。

其二，数字技术与实体经济的融合发展。重点抓住大数据、云计算、互联网等新一代信息技术的发展契机，在前沿的技术、材料、工具、软件等领域的持续突破。加快人工智能、5G等技术在服务实体中的重要作用，推动实体经济的智能化水平。加快利用数字技术，构建具有兼容性和高性能工业软件，高质量推动工业互联网平台发展。

其三，数字产业化和产业数字化发展。根据《中国数字经济发展研究报告（2023年）》测算，2022年中国数字经济规模达到50.2万亿元，其中数字产业化规模为9.2万亿元，占数字经济的比重为18.3%，产业数字化规模为41万亿元，占数字经济的比重为81.7%[⑦]。数字产业化是数字经济的核心产业，产业数字化是数字化的应用，数字产业化和产业数字化相辅相成，共同实现数字化融合发展。

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⑥ 隐私计算指的是在不发生原始数据泄露风险的前提下实现数据分析计算的技术集合，通过技术手段实现数据的“可用不可见”，从而保证数据安全并实现数据价值的最大化。

⑦ 资料来源：中国信息通信研究院《中国数字经济发展研究报告（2023年）》，http://www.caict.ac.cn/kxyj/qwfb/bps/202304/P020230427572038320317.pdf。

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（四）以服务乡村振兴重大战略为抓手，推动一二三产业融合发展

乡村振兴战略的行稳致远，关键在于乡村产业振兴。对于产业振兴而言，绝非就农业发展农业，而是需要不断拓宽农业的产业链条、提升增值环节，通过一二三产业融合发展，实现乡村产业振兴。依托农业生产所创造的物质基础，还需要充分依托工业化发展思维，推动初级农产品向精深方向升级，不断延长农业产业链，实现不同产业的融合发展。典型的是预制菜的蓬勃发展，根据《2022年中国预制菜产业发展白皮书》数据，2022年中国预制菜市场规模为4196亿元，并且处于快速增长的产业发展时期。预制菜涉及农业生产、储存运输、加工流通、餐饮、市场消费等环节，以市场的切实需求为导向，推动一二三产业联动融合发展。同时，还需要充分依托数字经济的有利因素，利用数字化手段实现三产融合。目前，根据《中国数字经济发展研究报告（2023年）》测算，2022年中国第一产业的数字经济渗透率为10.5%，远远低于二三产业数字经济渗透率24.0%和44.7%[⑧]，因此，如何利用数字经济发展契机，推动农业数字化并赋能一二三产业融合发展，具有巨大的发展空间。当然，依托新型农业经营主体推动产业链延伸、内部融合、多功能拓展、技术渗透，也是推动农村产业融合发展的重要抓手（赵雪等，2023）。

（五）多维协同为引领，以产城融合、城乡融合、区域融合推动产业融合发展

产业融合是产城融合、城乡融合、区域融合的本质。因此，产业融合发展并不是孤立的发展，而是需要将“产业”融合和“区域”融合相衔接，走相互促进的发展之路。中国不同地区产业发展存在差异性，不同地区的发展水平更是存在差异性。因此，以产业融合发展推动制造业高质量发展存在区域的差异性。全国上下需要一盘棋，实现产业融合发展与区域融合发展的统一，加快打造全国一体化的要素市场和产品市场，降低市场摩擦性成本，从而加速各项资源的自由流动，推动创新要素迸发活力，形成产业融合与区域融合的要素基础条件。政府更需要推动透明高效行政职能建设，降低制度性的交易成本，消除区域之间、产业之间的壁垒，形成有利于产业、产城、城乡、区域等不同维度融合的制度基础。加快建设新兴产业集群，尤其是重点打造具有国际竞争力的数字经济产业集群，引领产业融合发展。不同地区需要结合已有的要素禀赋优势、产业技术条件、市场发展程度，在遵循竞争优势、错位发展的原则下推动集群发展。最后，产业融合发展需要循序渐进地推动，在此基础上协调好产城、城乡再到区域融合之间的内在关联。

六、依托产业融合推动制造业高质量发展的政策建议

（一）提升资源配置水平

加快构建高效的市场机制，发展和完善产权市场，在法律法规层面对数据产权进行合理界定，

[⑧] 资料来源：中国信息通信研究院《中国数字经济发展研究报告（2023年）》，http://www.caict.ac.cn/kxyj/qwfb/bps/202304/P020230427572038320317.pdf。

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促进生产资料在产业链上下游之间的自由流动。强化供应链管理，支持并引导企业进行数字化转型，合理运用数字技术优化供应链管理，推动企业在缩减储存成本的同时提高响应速度。此外，在重点领域布局一批国家制造业创新中心，政府通过研发补贴、优惠贷款和税收减免等手段实现对高新技术企业的扶持，吸引高精尖企业及与之相匹配生产要素的聚集。加强与高等教育机构及科研机构等专业部门的合作，推动产学研深度融合，为制造业高质量发展做好基础保障。引导金融机构开发支持性的产业基金，鼓励金融机构为制造业优化提升项目提供定制化的融资解决方案，促进项目的顺利落地。加速推动与全球供应链的紧密合作，积极吸收、改进现有生产技术，通过建立行业内数字平台，实现信息流、物资流和资金流的高效运作。

（二）聚焦产业技术融合

推动数字技术与制造业深度融合，鼓励制造业企业引入机器学习、人工智能等先进技术，实现生产的半自动化乃至自动化，利用大数据、人工智能、物联网提升制造业生产效率。基于物联网的实时跟踪和分析工具实现对供应链管理的优化，相关部门要积极在关键区域部署高质量网络，为物联网的正常运行提供基础保障。加强数据分析和决策支持，鼓励制造业企业引入大数据分析工具，用于产品设计、市场分析和质量控制，建立行业数据交换平台，推动数据在企业间和政府间的自由流动。支持虚拟仿真与远程协作模式蓬勃发展，推进云计算和虚拟现实技术与制造业的深度融合，尝试建立跨地域、跨企业的远程协作平台，使中小企业也能有机会利用研究机构或其他大型企业的资源。利用大数据等分析工具，提高市场需求和消费者行为识别准确度，更快地响应市场变化。加强技术合作与交流，也需要合理确定技术研发与技术引进之间的距离与比例，遵循“自创为主，引创结合”的原则，处理好技术引进与自主创新之间的关系，实现较高水平的创新绩效。针对在国外已经逐步走向成熟的关键技术，积极推动从“know how”向“know why”的转变，组织专家骨干团队对外源性技术的消化吸收和再创新，努力掌握关键技术、默会知识与技术诀窍，逐步向具有自主知识产权的自主设计、自主制造转变，高质量做好引进技术内部化的发展步伐。

（三）推动区域协同发展

推动区域产业联盟的建设落地，将相邻地区制造业企业、高校、研究机构和政府部门进行有机连接，共享资源和信息，从而形成对周边地区的辐射带动作用，优化区域内互联网、物流、交通等基础设施的建设。根据不同地区资源禀赋及区位条件，有针对性地进行政策制定，推动产业精细化及专业化建设，形成区域特色产业，确保欠发达地区具有同样的发展机会。鼓励发展绿色制造和循环经济，通过环境税、碳交易和补贴等经济手段推动制造业的长期可持续发展，同时设立企业社会责任评价标准，通过税收优惠或其他激励措施鼓励企业履行社会责任。在相关政策及规则制定时，区域之间也需要协同，避免实施过程中的歧视，从而增加市场参与者的信心，营造稳定、公平、透明、可预期的发展环境。

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（四）加快培育人才梯队

人才是推动产业融合与制造业高质量发展的关键，是决定各项攻坚克难、推动创新发展的重要载体。政府需要花大力气推动涉及人才激励的各项制度改革，以物质待遇招人、以情感激励塑人、以宽松环境育人、以激励机制留人，推动人才队伍的合理流动与适度集聚，实现人才队伍的优化配置。加强政府、企业和教育机构三方面的密切合作，为企业实现从“专精特新”到“小巨人”再到行业龙头提供坚实的人才基础。积极推行产业特聘专家制度，实施高端产业人才引进计划。建立并完善多渠道、多层次、广覆盖的“弹性育才机制”，依托知名高等院校、科研院所，培育一批科学研究型专家队伍。依托工程研究中心和重点实验室，培育一批技术开发型专家队伍。建设一批实践操作能力强、专业技术技能水平高的专业技术人才队伍，形成多元化、多层次的创新人才队伍结构。

（五）营造良好营商环境

政府需要从竞争性的市场中退出，市场的东西交给市场，转而成为良性竞争环境的提供者。全面深化“放管服”改革，大幅度减少行政审批事项，将无关紧要的、非决定性事项通过待查、后补等形式予以安排，减少行政审批环节与过程，提高服务事项的运行效率，降低制造业的市场准入成本，鼓励企业更加专注于创新和高质量发展，推动跨领域跨行业协同创新。减少多部门对企业各项事权的分散审批与管理，大力推动一条龙服务和“只跑一次”改革，当好企业的“店小二”，有问必答、有事必办、随时受理、即时办结，真心实意为企业排忧解难。建立健全事中事后监管体系，营造国际化、法治化、便利化的营商环境。建立健全市场保护机制，加大知识产权保护力度，严厉打击侵权假冒行为，加强部门执法协作，将侵权行为纳入信用记录，加大侵权违法惩治力度，为企业的研发和生产活动提供安全保障。构建起“亲”“清”新型政商关系，提高政策的透明程度，培育提升综合竞争新优势，提高对外资外智的吸引力，以体制机制创新、营商环境优化助推产业融合与制造业高质量发展。

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Industrial Integration: Empowering High-Quality Manufacturing in the Era of the Digital Economy

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Abstract: *This paper investigates China's industrial integration in the era of the digital economy, evaluates its manifestations, identifies barriers to and opportunities for developing high-quality manufacturing through industrial integration, and suggests policy measures. In the era of the digital economy, data is the most vital resource in industrial integration. Platform companies operate in a dynamic business ecosystem that emphasizes user-centricity and uses innovation as its main engine to drive industrial integration. Industrial integration facilitates the shift from comparative and latecomer advantages to competitive strength, accelerating demand-side upgrades and supply-side structural reforms for the expansion of high-quality manufacturing. Industrial integration is expected to support the development of high-quality manufacturing in five distinct ways: Through integrated development between modern services and advanced manufacturing; through industrial chain integration; through integration of the digital and real economies; through integration of primary, secondary, and tertiary industries; and through urban-rural, industry-city, and regional integration.*

Keywords: *Industrial integration, manufacturing, digital economy, high-quality development*

JEL Classification Code: L16, L80, E61

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1. Introduction

Manufacturing is the cornerstone of a nation's progress and prosperity. A country's manufacturing capacity, innovation, and competitiveness form an economic pillar. The development of high-quality manufacturing is strategic and all-encompassing, and serves as the ballast for long-term macroeconomic performance. As General Secretary Xi Jinping stressed, "We should accelerate the development of a manufacturing powerhouse, develop advanced manufacturing, and integrate the internet, big data, and artificial intelligence into the real economy" (Xi, 2021). This comment sets the tone for China's development of high-quality manufacturing. China's large market and wide variety of manufacturing sectors have laid the groundwork for the country's rapid advancement toward excellence in manufacturing. In recent years, China has consistently expanded the development of high-quality manufacturing, and has consistently risen to the medium- and high-end links of global value chains,

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showing desirable development resilience.

As shown by China's experience since reform and opening up in 1978, the development of manufacturing cannot be achieved without gains in efficiency in the industrial division of labor, and that the country has participated in and excelled at certain processes within the industrial division of labor thanks to its comparative advantage. Changing productive forces and the relations of production are crucial for the development of high-quality manufacturing in the new digital economy characterized by a shift from the industrial division of labor to industrial integration. While maintaining the advantages of a highly specialized division of labor, industrial integration can reduce supply chain risk, lower transaction costs, and boost operational efficiency by recombining existing labor chains and bringing previously outsourced activities back in-house, leading to an increased overlap between different manufacturing sectors, from which new types of industrial activity have emerged to propel the development of high-quality manufacturing. Rising sophistication during the transition from inter- to intra-industry division of labor has improved manufacturing efficiency, allowing manufacturers to provide consumers with low-priced, high-quality industrial products. This, however, has come at the price of sacrificing manufacturing heterogeneity. As a result of mass production geared toward satisfying broad customer demands, preferences for unique products have been ignored. However, in today's data-driven economy, businesses can better fulfill their customers' unique wants and needs thanks to data collected by digital applications. Industrial integration has become an important vehicle for the development of high-quality manufacturing. As such, it is important to examine the features of industrial integration in the era of digital economy, to determine its manifestations, how it aids in the development of high-quality manufacturing, and to propose relevant policy suggestions.

2. New Characteristics of Industrial Integration in the Era of Digital Economy

2.1 Data Factor: Critical Resource for Industrial Integration

In the past, labor, capital, and technology were considered key factors of production. In the era of the digital economy, an entirely new factor of production, the digital factor, assumes center stage. Complete integration of the data factor with other production factors has magnifying, overlapping, and multiplying effects. One distinguishing feature of industrial integration at the microscopic level is the amalgamation of data and other production factors to generate enabling effects on a massive scale.

The data factor facilitates industrial integration through the implementation of intelligent and automated manufacturing processes, which enable the production of a wide variety of products at a modest cost in fulfillment of specific customer demands. The data factor ensures the timely and accurate delivery of products to users by matching supply and demand, eliminating information asymmetry between producers and consumers. Data-enabled industrial integration, particularly integration between traditional and data-generating businesses, has displayed significant development momentum, revolutionizing the development concept, business model, and industrial landscape (Ren, 2023). For instance, based on consumer data, Kutesmart[1], a manufacturer of custom apparel, has implemented an intelligent matching system to replace laborious apparel design. In this case, data has become a strategic asset in the context of industrial integration.

2.2 Innovation: Primary Driver of Industrial Integration

Innovation provides the means to achieve industrial integration. Smartphones, as an example,

[1] Kutesmart has transitioned from custom apparel to intelligent customization services, and upgraded to creating a C2M industry internet platform ecosystem, providing personalized customization solutions for intelligent manufacturing, and digital governance providers. It is a typical case of industrial integration in the era of digital economy.

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constitute an ecosystem comprising software applications, content services, operating system, and hardware components. All these elements are critical for facilitating the various application scenarios and delivering a variety of content services. Likewise, intelligent cinematographic features have revolutionized the culture industry. In terms of box office earnings, Wandering Earth and Wandering Earth II ranked fifth and tenth, respectively, in the history of China's film industry, with sums in excess of 4.68 billion yuan and 4.02 billion yuan[2]. This success would not have been possible in the absence of a sophisticated film industry. The film series features, among other high-tech effects, extensive virtual production, age-altering AI, and virtual locations. AI applications have inspired innovations within the film industry, creating new possibilities for artistic manifestation. In another instance, internet applications have revolutionized the automotive sector through the transformation of conventional vehicles into intelligent ones equipped with man-machine interfaces, varied usage scenarios, and exciting innovations.

2.3 User-Centric Approach: Fundamental Concept of Industrial Integration

"People's desire for a better life is what we aim to achieve" (Xi, 2023). The term "good life" has different connotations at different times. Advances in productivity have contributed to the increased sophistication of manufacturing processes. As a result, businesses are better positioned to meet the varied preferences of their customers. This is where user-centric industrial integration becomes an important factor. For consumer-facing light industries, the user-centric approach is important to meet the growing demand for customized products and services. Within the textile industry, Kutesmart collects individualized customer requirements using intelligent tools and compares them to clothing big data. The utilization of the man-machine interface enables the tailoring of garments according to consumer specifications. By leveraging AI-driven applications and big data, technology-industry integration offers a viable way to meet the individualized needs of consumers.

Industrial integration fulfills user requirements in three ways. First, it fulfills composite user requirements. For example, diverse industrial forms have been blended in the composite business sector of culture and tourism. One such blend is the combination of agriculture with tourism and culture. Second, industrial integration facilitates the fulfillment of specific needs and preferences. In numerous industries, the digital economy has revolutionized business operations by providing a way to meet specific requirements via customized manufacturing. The arrival of digital applications has transformed the way in which consumers make a purchase. Intelligent and customized recommendations address consumers' specific needs and preferences. Third, industrial integration at the highest level may create a brand-new market. Consumers often find it difficult to precisely define what they want until a new service or product enters the market. On the eve of the invention of smartphones, for instance, consumer demand for telecom devices was basically limited to voice and messaging. Overnight, new features of smartphones sparked an unprecedented surge in consumer interest. In this situation, a new type of consumer demand emerged as a result of industrial integration.

2.4 Platform Companies: Implementing Agencies for Industrial Integration

Traditional industrial integration is displayed in the form of systematic integration at the industry level, in most situations entailing the integration of two or more industries that have common characteristics. An example is the digital integration of telecom, TV and internet networks (Zhou, 2003). Platform companies, which connect both ends of a network-based platform in the shape of a dumbbell, facilitate industrial integration in the era of the digital economy. Nowhere is this phenomenon more striking than in the industrial internet. There are more than 240 industrial internet platforms in

[2] Source: "Total box office of Cat's Eye films", https://piaofang.maoyan.com/mdb/rank.

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China that produce integrated applications[3]. With the accumulation of massive user data as a result of their day-to-day activities, platform companies have evolved into a conduit for industrial integration. The data factor has become the most valuable asset of platform companies in fostering cross-sectoral integration. COSMOPlat is an example of new channels for the integrated development of conventional sectors, propelling the evolution of technological paradigms through data analytics. At the same time, participants in the platform ecosystem have established mutually beneficial associations with platform companies, as the latter are able to coordinate diverse resources within their value chains. Due to their market dominance and supply chain advantage, platform companies are able to coordinate upstream and downstream businesses and direct all participants toward integrated development.

2.5 Vibrant Ecosystem: Cornerstone for Industrial Integration

The integration of conventional industries is relatively simple, and tends to take the forms of technology integration and business integration. Industrial integration has not transformed the fundamental rationale of traditional industries. For instance, the integration of telecom, TV and internet networks is undergirded by different network technologies, which are essentially channels of information transmission. Integration does not change the technology pathways for those sectors, nor does it create a complex industrial ecosystem. In the era of the digital economy, integration has become more complex, involving the digital economy and other sectors. The digital economy has blurred the boundary between sectors and expanded their scope, creating brand-new business modes. The participants, corporate clusters, competition-cooperation relationships, and the external environment have become more complex, generating vibrant industrial ecosystems.

First, a greater variety of business entities have taken part in the business ecosystem. Industrial integration involves platform, backbone and application enterprises at different positions of the business ecosystem. Second, business clusters have developed a distinctive dumbbell structure, in which upstream supporting and downstream application industrial (business) clusters comprise both ends of the dumbbell and platform companies comprise the bar. Third, business entities form an ecosystem with an orientation of meeting user requirements. Lastly, complexity has increased in the external environment. In the past, enterprises could gain access to market with their comparative advantages, but in the era of the digital economy, they must have unique competitive strengths in order to be admitted to an ecosystem. In other words, the competitive relationship has shifted from one between enterprises to one between ecosystems. Businesses share their destinies with an ecosystem. The cost of failure in competition means the failure of an entire ecosystem. In the worst circumstance, it may result in a systematic exit from the market.

3. Manifestations of High-Quality Manufacturing Development Driven by Industrial Integration

3.1 New Concept of Industrial Integration: Key Aspect of High-Quality Manufacturing Development

The new development concept refers to innovative, coordinated, green, inclusive and shared development. It is a major strategy by which China promotes high-quality economic development in the new normal. More importantly, it sets the tone for a major transformation of China's overall development. In this sense, in its development, high-quality manufacturing should be innovative, coordinated, green, and inclusive with shared benefits. Industrial integration accompanies the new development concept. Specifically, in its development, high-quality manufacturing is characterized by innovation and by being coordinated, green and inclusive for shared benefits.

[3] Source: 52nd *Statistical Report on China's Internet Development*, https://www.cnnic.net.cn/n4/2023/0828/c88-10829.html.

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Innovation, a new feature of industrial integration in the era of the digital economy, is the main driver of integrated industrial development. The process of integration will stimulate multiple innovations in the domains of 5G, big data, and cloud computing. These innovations will have a profound effect on current business models and accelerate institutional and regulatory changes. Furthermore, industrial integration may result in the restructuring and optimization of resource factors, particularly the incorporation of digital and data technology into conventional production factors, in order to improve compatibility and efficiency, facilitate coordination among industries, and enable dynamic industrial upgrading via technological advancement. In addition, industrial integration will reduce repetitive investment on generic technologies. One example is the integration of telecom, TV and internet networks. The result is a more inclusive network that avoids redundancies and promotes environmentally sound practices. Industry integration is conducive to the collection of various resources, especially innovation resources, for inclusive and shared development and competitiveness. Inclusive access to value chains and ecosystems results in more efficient factor combinations and manufacturing modes, facilitating the rise of global value chains under the condition of global openness. Lastly, industrial integration has commonalities with the shared economy. Integration is an intrinsic attribute of shared development, and shared development lies at the heart of integration. Both the consumer internet and the industrial internet are products of integrated development and "quasi-public goods", which share common characteristics and assure manufacturing excellence.

3.2 Transition from Latecomer Advantage to Comparative and Competitive Advantages

From reform and opening up in 1978 to the present time, China has made great efforts to grow into a global manufacturing powerhouse. "It took China decades to complete an industrialization journey that developed nations required centuries to complete", as the adage goes[4]. China showed tremendous vitality during this phase of development in which human capital, institutional reform, and a massive consumer market were utilized. China used its comparative advantage to participate in the international industrial chain division of labor and used its latecomer advantage to advance reform and opening up. Obtaining such "low-hanging fruit" will become increasingly difficult in the future. China has transitioned from being a follower to becoming a parallel runner in certain sectors, such as high-speed rail, ultra-high voltage power transmission, and photovoltaic energy. This transformation has been greatly influenced by industrial integration.

Industrial integration holds the key to unlocking China's strengths in a complete range of manufacturing sectors and an ultra-large market. Through technological integration, enterprises seek to match supply with demand. China's complete range of manufacturing sectors provides industrial integration with essential technologies and production factors. Its ultra-large market creates great potential for new products generated by industrial integration. According to the 52nd *Statistical Report on Internet Development in China*, China had 1.079 billion netizens in June 2023[5]. An integrated business mode or application may easily acquire tens or even hundreds of millions of users in China.

Furthermore, industrial integration has the potential to reduce expenses by leveraging data and technology factors. In the presence of network externalities, the "winner takes all" Matthew Effect will materialize. Through industrial integration, a limited number of participants will amass a lion's share of the market and obtain a competitive edge. Industrial integration will generate a multitude of new sectors, business models, and market segments, as well as fresh consumption scenarios and applications. As a result, economies of scale and comparative advantage will no longer be viable means of achieving success. Companies must actively pursue opportunities in niche markets to enhance their competitive

[4] Source: *Resolution of the CPC Central Committee on the Party's Major Achievements and Historic Experiences over a Century of Struggles*, The People's Publishing House, 2021.

[5] Source: *52nd Statistical Report on Internet Development in China*, https://www.cnnic.net.cn/n4/2023/0828/c88-10829.html.

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advantage. The effects of industrial integration are interdependent and do not exist separately from one another. They work together in promoting industrial integration and facilitating the advancement of high-quality manufacturing through their support of the transition of manufacturing from one having a latecomer advantage to one based on comparative and competitive advantages.

3.3 Expediting Supply-Side Structural Reforms for the Development of High-Quality Manufacturing

"Supply-side structural reforms should focus on liberating and developing productive forces and expediting structural adjustment to reduce ineffective and low-end supply and expand effective and medium- and high-end supply" (Party Literature Research Office of the CPC Central Committee, 2017). It is through these avenues that industrial integration may assist supply-side structural reforms.

At the firm level, companies attempt to acquire business modules that maximize value and that are compatible with their current business models in order to align value creation and capture. For this to occur, corporate business lines need cross-departmental and cross-functional overlap. When companies broaden the scope of their business by integrating their products or services with those from other markets, the result is industrial integration, which is facilitated by innovation. The boundaries of industries that rely on generic technologies will diminish. Organizations must respond to market demands by diversifying their business lines along the curve of established technology and introduce new products or business models to foster industrial development.

At the industry level, industrial integration helps accelerate industrial restructuring, creates new business modes, and blurs sectoral boundaries through the integration of value proposition, technology and market (Hu and Xing, 2003). Such adjustment enables the optimization of the industrial structure for the improvement of supply-side total factor productivity (TFP), and helps increase supply. Specifically, industrial integration provides the means for conventional manufacturing to fully absorb advanced technology and concepts, and integrate factors of other industries for industrial transition, innovation and digitalization. As a result, conventional manufacturing as a share of the industrial system will continue to decline. Industrial integration will catalyze multiple new business modes and foster advanced manufacturing. For instance, industrial diagnostic systems arise from the application of medical systems in the industrial sector.

3.4 Propeling Demand-Side Upgrade for the Development of High-Quality Manufacturing

Industrial integration is production-side integration among industrial sectors. The fundamental concept of integration, however, is the user-centric approach. In other words, integration creates better goods and services to meet user requirements. Instead of the transfer of ownership rights, users wish to experience the utility of products or even the combination of products with different functions. This forces firms to broaden their business scope into sectors beyond the existing industrial boundary to strengthen their market positions. The blurred boundary among industrial sectors does not mean that those sectors become homogeneous over time. Instead, it signifies a growing degree of convergence and interdependence among formerly independent entities, such that industrial integration is propelled by the need for technological advancements. In the era of the digital economy, industrial integration has acquired new traits. New-generation information technology has catalyzed new business modes and use cases. As a result of business integration, new consumer demand has emerged to meet people's expectations for a better life in ways previously undreamed of. In the feature phone era, consumers used mobile phones primarily to make calls and send messages. By integrating mobile internet applications, smartphones have created myriad business modes and new demand with unprecedented user experiences. Demand-side industrial integration has blazed a new trail of manufacturing excellence.

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4. Barriers to Industrial Integration in the Development of High-Quality Manufacturing

In the era of the digital economy, industrial integration has only begun to drive the development of high-quality manufacturing. At this stage, various barriers and problems still exist, including resource mismatch, need for technology upgrade, lack of regional coordination, insufficient human resources, and poor business climate. Industrial integration has yet to break free from the old constraints and establish new drivers of manufacturing development.

4.1 Industrial Integration: Insufficient Support for Breaking Free from Old Manufacturing Constraints

Great progress has been made in digitalization and internet application in the manufacturing sector. However, the transition from mass production to individualized customization is incomplete. Services account for a modest share of input and output, and offer limited support to the extension, permeation and integration of manufacturing. Progress has yet to be made in the service-based transition. Industrial integration has yet to transform manufacturing processes, reshape value chains, and generate innovative business modes. Consequently, manufacturers cannot create a diverse range of individualized goods and services to meet heterogenous customer requirements, which is essential to raise the user experience to a higher level. More work needs to be done to break free from old constraints and complete the transition to digital and service-based manufacturing across all value chains, ecosystems and full-lifecycle management processes (Yang and Sun, 2023).

Moreover, there has been insufficient integration between the manufacturing sector and upstream and downstream enterprises. Manufacturing enterprises cannot optimize resource allocation on a real-time basis in response to changing customer requirements and domestic and international environments. Without access to integrated information, companies are hampered in their attempts at providing additional services, and face barriers to the integration of service and manufacturing. The benefits of industrial integration's allowance of the free flow of data have yet to be fully realized. The fragmentation of data resources impedes the availability and application of data, and prevents the complete realization of data's value for the society.

4.2 Industrial Integration: Insufficient Impetus for Manufacturing Innovation

There has been great momentum in digitalization and the rise of strategic emerging industries. In this context, China's support of technological, corporate and industrial innovation has been inadequate.

At the technology level, manufacturing has yet to unlock the potentials of new technologies such as the internet of things (IoT), big data, and cloud computing. As a result of the limited penetration of new technology, barriers still exist between networks, equipment, systems, and data. New-generation information technologies have yet to be fully integrated into the manufacturing sector.

At the firm level, manufacturing enterprises are not commonly capable of digital customization to meet customer requirements. Due to the lack of internet applications, it still takes hefty channel investments for firms to perceive and meet customer requirements.

At the industry level, the relationship among manufacturing enterprises is characterized by both competition and cooperation. It takes time for a symbiotic relationship to form. Integrated information and technology solutions should be adopted to blur the boundary among industrial sectors, increase efficiency in resource allocation, and catalyze new business modes for the development of high-quality manufacturing.

5. Industrial Integration: Towards a High-Quality Manufacturing Powerhouse

In the era of the digital economy, a step-by-step approach to industrial integration is needed to promote manufacturing excellence. Policymakers should encourage integration between manufacturing

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and services, industrial chain integration, and integration between digital and real economies, between primary, secondary and tertiary industries, encourage urban-rural, industry-city, and regional integration, thus promoting industrial integration..

5.1 Promoting Integration between Manufacturing and Service to Increase Manufacturing Competitiveness

The integration of manufacturing and service is not only the result of technological evolution, but also an important means for developing high-quality manufacturing, as shown in the emergence of new business modes, paradigms and paths. Specifically, there are two pathways for the development of the integration of manufacturing and service: Service-based and service-derived manufacturing. Service-based manufacturing refers to service applications in the manufacturing processes; service-derived manufacturing is led by platform companies that generate an ocean of consumer preference data and use such data to design new products for contract manufacturing.

As for specific types of industries, it is important to focus on core manufacturing sectors and promote all-round integration among material supply, consumer goods, and equipment and automobile manufacturing. Efforts should be made to extend, complement and strengthen manufacturing value chains. Manufacturers should expedite innovation, develop industrial software for assisted design and system simulation, and implement intelligent manufacturing processes. There are significant differences in the industrial foundation, inherent characteristics and development goals between light industry and heavy industry, leading to different paths of industrial integration. Light industries should create a modern service system combining product with content and a business ecosystem. Heavy industries should focus on a combination of industrial internet and professional services. Downstream manufacturing services should become greener, smarter and increase brand awareness to create superior services and concepts. Policymakers should encourage manufacturing-service integration in all dimensions, from internet applications to modern logistics, R&D and design, consumer services, and financial services.

5.2 Promoting Industrial Chain Integration to Reinforce Security and Stability

Countries should maintain the resilience and security of global supply chains as a quasi-public good while taking part in the international division of labor. Currently, advanced economies led by the United States have imposed restrictions on global supply chains, especially in strategic emerging industries, which present risks to supply chain stability and industrial sustainability. As far as China is concerned, supply chain stability is essential for businesses to survive and thrive. The more integrated supply chains are, the higher the level of security and stability. Supply chain integration is also a basic requirement for the development of high-quality manufacturing.

It is the responsibility of platform corporations, which dominate supply chains, to integrate the supply chain. Huawei, for example, has been committed to establishing sustainable, low-carbon, and environmentally friendly supply chains. Huawei specializes in the development of automotive operating systems and processors for smart vehicles. The chip product line comprises Kirin on-board chips and Ascend chips, while the operating systems comprise the intelligent driving operating system, smart vehicle control operating system, and Harmony cockpit operating system. Huawei is renowned in the smartphone supply chain for its exclusive Kirin processor and Harmony mobile operating system. It has put together a complete domestic supply chain including screen, RF chip, filter, optical camera, acoustic component, and battery module while establishing an ecosystem of software applications and content services[6]. The case of Huawei demonstrates that the dominant company in a supply chain determines the

[6] Source: *Huawei Investment Holding Co., Ltd. 2022 Annual Report*, https://www-file.huawei.com/minisite/media/annual_report/annual_report_2022_cn.pdf.

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technological trajectory, the development concept, and the course of the industrial chain evolution, as well as advancing the integration of the industrial chain. In fact, the integration of an industrial chain is impossible without a multitude of suppliers providing auxiliary and supportive applications and content vital to the integration of the industrial chain. Finally, industrial chain integration is demonstrated through the integration of personnel, capital, information, and logistics flows.

5.3 Promoting Integration between Digital and Real Economies to Unlock Future Industrial Potentials

The real economy, particularly manufacturing, cannot flourish without the assistance of the digital economy, and the digital economy cannot advance in seclusion from the real economy. The digital economy has evolved from a supplementary factor to the primary arena of economic progress. It also serves as a significant arena for competition among global powers. Three points may be critical for advancing the integration of the digital and real economies.

First, the digital factor facilitates the growth of the real economy. The Chinese government has repeatedly recognized data as a factor of production. The commercialization of data, which is a crucial component of the integration of the digital and real economies, raises three fundamental concerns: Data security, data ownership, and data pricing. As evidenced by the current trend, manufacturing companies have maximized the utilization of big data generated by their day-to-day operations, as these data resources are considered proprietary assets exempt from concerns regarding pricing, security, and proprietorship. The key question is how to leverage user data and government data to facilitate the advancement of the real economy. In particular, user data raises addressable concerns regarding data privacy and security. For example, privacy computing[7] presents a new methodology for rendering data "accessible but imperceptible". However, establishing the proprietorship of user data presents a greater difficulty, as it necessitates both theoretical deliberations and practical application. Two varieties of government data exist: Information is disseminated by the government for public oversight, and substantial economic value to the data is provided by government departments at all levels, including climatic, traffic, and medical information. It is imperative to conduct proactive research regarding the ownership, pricing and security of data.

Second, applications of digital technology in the real economy. It is imperative to capitalize on the opportunities presented by emerging information technologies of the next generation, including big data, cloud computing, and IoT, in order to consistently achieve advances in cutting-edge materials, instruments, and software. A greater role should be given to artificial intelligence (AI) and 5G in supporting the real economy. It is necessary to develop high-performance and compatible industrial software to support industrial internet platforms.

Third, digital industrialization and the digitalization of industries. Based on the findings presented in the *Research Report on Digital Economy Development in China*, the digital economy in China amounted to 50.2 trillion yuan. Of this amount, industrial digitalization accounted for 41 trillion yuan, or 81.7%[8], while the digital industry comprised 9.2 trillion yuan, or 18.3% of the digital economy. Industrial digitalization results from the implementation of digital technology; the digital sector is a fundamental sector of the digital economy. They play complementary roles in advancing digital integration.

5.4 Promoting the Integrated Development of Primary, Secondary and Tertiary Industries under the Strategy of Countryside Revitalization

The success of the countryside revitalization strategy is contingent upon the flourishing of rural

[7] Privacy computing refers to the collection of technologies that enable data analysis and calculation without the risk of raw data leakage. Through technological means, rendering data "accessible but imperceptible", ensuring data security and maximizing data value.

[8] Source: The Chinese Academy of Information and Communication Technology (CAICT): *Research Report on the Development of China's Digital Economy 2023*, http://www.caict.ac.cn/kxyj/qwfb/bps/202304/P020230427572038320317.pdf.

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industries. Rural industrial revitalization extends beyond agriculture, and is based upon the integration of agricultural value chains and those of the primary, secondary, and tertiary sectors. Agribusiness value chains should be extended and made more connected by combining farming operations with industrial development. This will encourage the intensive processing of farm produce. The rapid development of ready-to-eat meals is one example. The ready-to-eat meal market in China was valued at 419.6 billion yuan in 2022, as reported in the *White Paper on the Development of the Ready-to-Eat Meals Industry in China 2022*. This figure indicates that the market continued to expand at a rapid rate. The production, storage, transportation, processing, distribution, catering, and market consumption of ready-to-eat meals are all components of the food industry. In the primary, secondary, and tertiary sectors, integrated development is propelled by consumers' demand for ready-to-eat meals. The government ought to leverage advantageous aspects of the digital economy to foster digital application-based integration of the primary, secondary, and tertiary sectors. The penetration of the digital economy in China's primary industry is 10.9%, which pales in comparison with those of the secondary and tertiary sectors at 24.0% and 44.7%[9], respectively, as estimated in the *Research Report on the Digital Economy in China*. Thus, there are significant prospects for harnessing the opportunities presented by the advancement of the digital economy to digitalize agriculture and facilitate the integrated development of primary, secondary, and tertiary sectors. An additional approach to advancing rural industrial integration is to leverage the potential of emerging agribusinesses to facilitate the expansion, integration, and implementation of technologies along the industrial chain (Zhao et al., 2023).

5.5 Promoting Industry-City, Urban-Rural and Regional Integration

Integration of industries and cities, cities and rural areas, and regions are the three key types of industrial integration. Regional integration and industrial integration should be combined in order to reinforce one another. Variations in the degree of industrial and economic progress can be observed among different regions of China. Such regional disparities are reflected in the industrial integration-driven development of manufacturing. Policymakers should take a comprehensive approach to maximizing the synergy between industry and regional integration, establishing a national factor and product market, and lowering market friction costs. Only in this way can we speed up the free movement of different resources, boost the vitality of innovative factors, and set the stage for industrial and regional integration. It is recommended that the government establish institutional frameworks that facilitate multidimensional integration among regions, industries, cities, and rural areas, and also reduce transaction costs associated with institutions and eliminate barriers between regions and industries. In order to spearhead industrial integration, the government should expedite the growth of emerging industrial clusters, with a particular emphasis on digital economy clusters that are globally competitive. Localities ought to evolve into regional communities that possess distinct functionalities, in accordance with their individual technological and market development levels and competitive advantages.

6. Policy Recommendations for the Development of High-Quality Manufacturing Driven by Industrial Integration

6.1 Improving Resource Allocation

In order to facilitate the unrestricted flow of data, the government should establish data ownership rights at the legislative level along with efficient market mechanisms for data transactions. The digitalization of supply chain management should be promoted to decrease inventory expenses and improve the response rate of businesses. Establishing national manufacturing innovation centers in

[9] Source: The Chinese Academy of Information and Communication Technology (CAICT): *Research Report on the Development of China's Digital Economy 2023*, http://www.caict.ac.cn/kxyj/qwfb/bps/202304/P020230427572038320317.pdf.

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strategic regions is imperative. The government should assist high-tech businesses and draw in resources by providing R&D subsidies, preferential loans, and tax credits. Businesses should increase their collaboration with universities and research institutions in order to enhance their manufacturing prowess. Financial institutions should be directed to establish industrial funds and promote the provision of financing options for the purpose of optimizing manufacturing processes and executing projects. To establish efficient flows of information, materials, and capital, businesses should build digital platforms within their respective industries, collaborate closely with global supply chains, and enhance their technology.

6.2 Focusing on the Integration of Industrial Technology

It is recommended that the government encourage manufacturing enterprises to embrace advanced technologies, including machine learning and AI, in order to achieve complete or partial automation. The implementation of big data, AI, and IoT could be leveraged to enhance manufacturing efficiency. Adopting real-time IoT analysis and tracing tools is essential for optimizing supply chain management. Proactive measures should be taken to establish high-quality networks in critical areas to facilitate IoT operations. The adoption of big data analytics by manufacturing enterprises for the purposes of product design, market analysis, and quality control should be promoted to strengthen data analytics and provide decision-making support, and industry data transaction platforms should be established to facilitate the unrestricted exchange of data between government agencies and businesses. It is necessary to provide support for virtual simulation and remote collaboration, implement cloud computing and virtual reality (VR) in the manufacturing sector, and establish platforms for cross-enterprise and cross-regional remote collaboration. This will enable small and medium-sized enterprises (SMEs) to leverage the resources of large enterprises and research institutions. Adopting big data analytics would increase the precision of the identification of consumer behavior and market demand, allowing for a quicker response to market shifts. When engaging in technology cooperation and exchange, it is crucial to establish a rational correlation between the proportion and distance between in-house technology research and development and technology imports. Placing emphasis on independent innovation, businesses ought to strike a balance between technology importation and independent innovation. Businesses should transition from “know how” to “know why” when importing mature technologies, engage in exogenous technology assimilation, absorption, and re-innovation, acquire critical technology, know-how, and technical expertise and transition to independent design and manufacturing with indigenous intellectual property rights.

6.3 Coordinating Regional Development

Establishing regional industrial alliances would facilitate the exchange of resources and information among manufacturing enterprises, universities, research institutions, and government agencies in neighboring regions. This would generate spillover effects that would benefit neighboring areas and contribute to the improvement of internet, logistical, and transportation infrastructures. Policymaking should be based on the location and resources of each region in order to support regional industries and make sure that less developed regions have equal development opportunities. The circular economy and green manufacturing should be promoted through economic mechanisms including environmental taxes, carbon trading, and subsidies. Assessment criteria need to be established for corporate social responsibility (CSR) to provide incentives, such as tax credits, for CSR performance. Policy coordination should be undertaken by regions to prevent discrimination, bolster market participants’ confidence, and establish a policy environment that is stable, equitable, transparent, and predictable.

6.4 Cultivating a Talent Echelon

Talent is essential for industrial integration and the development of high-quality manufacturing. The brightest minds solve complex problems and propel innovation. Greater efforts should be made by the government to reform talent incentives and foster an environment conducive to talent. Talent concentration and mobility should be encouraged in order to maximize talent distribution. A more

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intimate collaboration among the government, businesses, and universities is required to cultivate talent for "little giant" enterprises, which are specialized and sophisticated producers of novel and distinctive products, as well as industry leaders. It is advised to develop a distinguished expert system and a high-end talent attraction program. Prestigious universities and research institutions should support the development of a constellation of scientific research professionals, and flexible systems for fostering talent should be built with broad coverage at all levels. The cultivation of technology development experts ought to be undertaken in collaboration with engineering research centers and key laboratories. Additionally, training should be provided for technicians who possess practical experience in order to construct a multifaceted and varied framework of innovation talent.

6.5 Creating a Pro-Business Environment

To foster an environment conducive to competition, the government must abstain from unnecessary intervention and withdraw from competitive markets. It is suggested to deepen reforms of administrative devolution, management, and services. This could involve reducing the number of items requiring administrative review and approval, implementing ex-post supervision for non-decisive and unnecessary matters, and enhancing the operational efficiency of service-related issues to facilitate market access of the manufacturing industry at a lower cost, as well as encouraging enterprises to prioritize cross-sectoral innovation. It is recommended that the government streamline the decentralized review and approval process for administrative matters across multiple departments and establish one-stop services that efficiently and promptly attend to the requirements of businesses. An interim and ex-post regulatory framework should be established, while fostering a business environment that is standardized, lawful, and globalized. Safety assurance for corporate R&D and manufacturing activities can be achieved through the following measures: Protect intellectual property rights, clamp down on counterfeits and infringements, increase law enforcement cooperation, report infringements on credit reports, and strengthen penalties for infringements. The government ought to cultivate amicable and legitimate relations with businesses, enhance the transparency of policies, establish fresh competitive advantages, augment appeal to foreign capital and talent, and support the development of high-quality manufacturing and industrial integration through institutional innovation and the improvement of the business environment.

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