

**Local firm Capabilities & Industrialization
through Global Value Chains:**
*Methodological Innovations in measuring
technological capabilities*

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Why is this topic important?

- **Growing consensus** in development economics that structural transformation is necessary for sustained poverty reduction, and that industrial policy is necessary to drive transformation
- **Debate moved not just from the need for targeted IP, but what exactly should it be doing?** → not only overcoming external constraints on productivity, but also internal ones:
 - facilitating learning and the building of technological/organizational capabilities, defined by tacit knowledge
 - EX: J. Stiglitz, 2016 WIDER working paper, 'Industrial policy learning and development'
 - EX: Newman et al. (2015), *Made in Africa: Learning to compete in industry*
- **IP is sector specific, and so are TCs** → we need a way to measure and assess TCs that captures this complexity
- **How we measure and assess TCs, leads to different conclusions about what kind of TCs are required in export sectors, and how firms learn and acquire these capabilities** → which is necessary to design IPs that facilitate learning and TC building among local firms

Contributions of this paper

Conceptual contribution:

- Revive the technological capabilities approach pioneered in the late 1980s
- Adapt to the contemporary global economy context → exporting in manufacturing and agribusiness sectors means entering GVCs.

Methodological contribution:

- TCs are not visible, so hard to measure and assess
- Therefore, have to measure 'revealed capabilities' —indicators of TCs
- But the question is how close we can get to actual capabilities
- Drawing on methods used in TC approach literature, we can get closer than studies that use general measures of productivity and product quality
- ***We construct a complex measure of GVC-specific TC***
- Applied this method in four cases: apparel in Ethiopia and Mada, and floriculture in Ethiopia and Kenya

TC approach

Definition of technological capabilities

- the technical, organizational and managerial skills that firms need in addition to formal education and scientific knowledge in order to achieve the level of productivity that established firms have achieved and which set the (international) market standard.
- They are firm-specific form of knowledge: tacit knowledge, cumulative, gained through learning-by-doing but also active search and learning.

The TC literature provides a method for moving from an abstract concept to something that can be operationalized through concrete descriptions of the capabilities demanded in particular industries

- Matrix pioneered by Sanjaya Lall (1992)

Table 1. Illustrative matrix of technological capabilities

		FUNCTIONAL						
		INVESTMENT		PRODUCTION			LINKAGES WITHIN ECONOMY	
		PRE INVESTMENT	PROJECT EXECUTION	PROCESS ENGINEERING	PRODUCT ENGINEERING	INDUSTRIAL ENGINEERING		
D E G R E E O F C O M P L E X I T Y	B A S I C	SIMPLE, ROUTINE (Experience based)	Prefeasibility and feasibility studies, site selection, scheduling of investment	Civil construction, ancillary services, equipment erection, commissioning	Debugging, balancing, quality control preventive maintenance, assimilation of process technology	Assimilation of product design, minor adaptation to market needs	Work flow, scheduling, time-motion studies. Inventory control	Local procurement of goods and services, information exchange with suppliers
	I N T E R M E D	ADAPTIVE DUPLICATIVE (Search based)	Search for technology source. Negotiation of contracts. Bargaining suitable terms. Info. systems	Equipment procurement, detailed engineering, training and recruitment of skilled personnel	Equipment stretching, process adaptation and cost saving, licensing new technology	Product quality improvement, licensing and assimilating new imported product technology	Monitoring productivity, improved coordination	Technology transfer of local suppliers, coordinated design, S&T links
	A D V A N C E D	INNOVATIVE RISKY (Research based)		Basic process design. Equipment design and supply	In-house process innovation, basic research	In-house product innovation, basic research		Turnkey capability, cooperative R&D, licensing own technology to others

Apparel GVC Technological Capabilities Matrix

(FUNUP)	Process (PROCUP)	Product (PRODUP)	Linkages: Supply chain (SCUP)	Linkages: Logistics, finance & support	End market (EMUP)
CMT – subcontracting	Controlling production costs (meeting price points, working capital/inventory management); Controlling quality (at end of line/multi stage in-line, fulfilling defect/reject rates); Controlling production reliability; Controlling production lead times & flexibility; Machinery, equipment & plant layout maintenance & improvements; Labour productivity improvements & continuous training; Compliance with safety standards; Compliance with labour & environmental standards	Producing according to sample received from first tier supplier; Fulfilling volume requirements (large/small); Increasing variety of products; Shifting to higher value products (complexity, fashion, lead times); Managing & improving volume flexibility; Investing in & improving finishing equipment	Links to other firms & collaboration in collective schemes; Participation in industry association	Containing & re-negotiating contracts with utility & service providers (electricity, water, transport, etc.); Dealing with investment & working capital finance; Relation with training institutes; Relations with consultants; Link to state support institutions & participation in initiatives	Managing relationship with first-tier supplier(s) (communication, negotiation, potential audits); Manage first-tier supplier diversification
CMT – direct buyer link		Pattern/sample making based on buyers' design & specifications; Fulfilling sampling lead times	Assurance of systematic separation of buyers' inputs & finished products; Conformity to buyers' storage norms		Managing relationship with buyer (s) (communication/account management, negotiations, audits); Manage market diversification; Manage buyer diversification; Increase market intelligence gathering
Full Package/FOB/OEM	Controlling total supply chain costs (total inventory management); Controlling total supply chain lead times & flexibility; Supply chain management improvements		Managing input sourcing (fabric/yarn, trims/ accessories, packing material); Managing support service provision (embroidery, washing, dyeing, etc.); Localization of input & service sourcing; Managing subcontracting linkages		Managing input sourcing finance & related instruments (L/C); Managing part of transport of inputs & outputs (transport, logistics, customs clearance, etc.)

(FUNUP)	Process (PROCUP)	Product (PRODUP)	Linkages: Supply chain (SCUP)	Linkages: Logistics, finance & support	End market (EMUP)
ODM		Investing in Computer-Aided Design (CAD) equipment; Design & CAD capabilities & provision of design services; Product development capabilities & management; Improvements in design & product development	Improving supplier relations & cooperation for product development	Managing design & product development finance	Offering & selling own design to buyer(s); Investing in market & buyer research
Textile	Controlling production costs; Controlling quality; Controlling production reliability; Controlling production lead time & flexibility; Machinery, equipment & plant layout improvements; Compliance with safety & environmental standards	Produce according to buyer requirements; Product development capabilities & management; Increasing variety of products; Shifting to higher value products; Add dyeing & laundry facilities; Access to or own laboratory for chemical tests	Links to other firms & collaboration in collective schemes; Participation in industry association (if textile specific); Managing input sourcing (cotton, other fibres); Managing support service provision (dyeing, laundry, etc.); Localization of input & service sourcing	Containing & re-negotiating contracts with utility & service providers; Dealing with investment & working capital & input sourcing finance; Managing part of transport of inputs (transport, logistics, customs clearance, etc.); Relation with training institutes; Relations with consultants; Link to state support institutions & participation in initiatives	Offering & selling apparel products with own textile inputs to buyer(s); Offering & selling to apparel firms in country or region if textile production higher than required for own apparel production

Moving from Matrix to Measurement

Create indicators

- Used knowledge of the apparel GVC and global industry standards to create indicators, and adapted to low-income country situation where necessary

Design survey to collect data on indicators

- Through a specially designed survey instrument that was specific for apparel GVC, for example
- quantitative indicators and qualitative questions used to make a subjective assessment; multiple questions for triangulation

Administered survey to firm owners and production managers

- This method requires generating own data to be used in assessing firm-level TCs

Indicators in Scoring Apparel Exporting Local Firms

Function: CMT-Subcontracting=1, CMT=2, FOB=3, FOB-Textile (madeups)=3, FOB-Textile (apparel)=4, ODM=5

Sum score: Low= 1-2, Medium= 3, High= 4.

Product capabilities

Indicator 1: Complexity of products: Basic=1, Intermediate= 2, Complex=3.

Indicator 2: Variety of products: Low (1 product)= 1, Medium (2 or 3 products)= 2, High (4 or more products)= 3.

Production capabilities

Indicator 1: Labor productivity: Low (below 60%)= 1, Medium (60 to 75%)= 2, High (above 75%)= 3.

Indicator 2: Not on time delivery: Often (5% and above)=1, Sometimes (2-4%)= 2, Hardly ever (1% and below)= 3.

Indicator 3: Internal reject rate: Often (5% and above)=1, Sometimes (2-4%)= 2, Hardly ever (1% and below)= 3.

End-market capabilities

Indicator 1: Number and dominance of buyers: Low (dependent on 1-2 buyers)= 1, Medium (3-4 buyers)= 2, High (5+ buyers)= 3.

Indicator 2: Stability of buyers: Low (unstable/ad hoc)= 1, Medium (somewhat stable)= 2, High (stable)= 3.

Linkage capabilities

Indicator 1: Links with other apparel firms: Low= 1, Medium= 2, High= 3.

Indicator 2: Links with public sector institutions: Low= 1, Medium= 2, High= 3.

Ethiopian-owned Apparel Firms Technological Capabilities Scores

	Function	Product			Production				End-market			Linkages				
Firm		Complexity of main products	Variety of products	Sum score*	Labor productivity	Not on time delivery	Internal reject rate	Sum Score **	Nr. & dominance of buyers	Stability of buyer relations	Sum Score*	Links with other firms & experts	Links with public sector institutions	Sum Score*	AGGREGATE SCORE	
A-FIRM	3 M	1	1	2 L	N/A	1	2	L	2	3	5 M	1	2.5	3.5 L	MLLML	MED-LOW
B-FIRM	3 M	1	1	2 L	N/A	X	X	L	1	2	3 L	1	2.5	3.5 L	MLLLL	LOW
C-FIRM	4 H	1.5	3	4.5 M	2	2	2	6 M	2	3	5 M	2	2	4 M	HMMMM	MED
D-FIRM	2.5 M	1.5	2	3.5 L	2	3	2	7 M	2	2	4 M	2	2	4 M	MLMMM	MED
E-FIRM	4 H	1	1	2 L	1	2	2	5 L	2	2	4 M	1.5	2	3.5 L	HLLML	MIXED
F-FIRM	2 L	2	2	4 M	2	2	2	6 M	1	3	4 M	1	1.5	2.5 L	LMMML	MED-LOW
G-FIRM	2 L	2	2	4 M	2	2	2	6 M	1	3	4 M	1	2	3 L	LMMML	MED-LOW
H-FIRM	2.5 M	2	3	5 M	2	1	2	5 L	1	2	3 L	1	2	3 L	MMLLL	MED-LOW
I-FIRM***	3 M	1	2	3 L	1	2	2	5 L	1	2	3 L	1	2	3 L	MLLLL	LOW
J-FIRM	3.5 H	1	2	3 L	1	1	1	3 L	1	1	2 L	2	2	4 M	HLLLM	MIXED
K-FIRM	2 L	1	1	2 L	1	3	1	5 L	1	2	3 L	1	1.5	2.5 L	LLLLL	LOW
L-FIRM	2 L	1.5	1	2.5 L	1	3	1	5 L	1	1	2 L	1.5	2	3.5 L	LLLLL	LOW
M-FIRM	2 L	1	1	2 L	1	X	2	L	1	1	2 L	1	2	3 L	LLLLL	LOW
N-FIRM	2 L	2	1	3 L	1	X	1	L	1	1	2 L	1	2	3 L	LLLLL	LOW

What we can see by using this method

- **Building capabilities in different categories takes place unevenly**, which is related to the functions that firms have, the end-markets firms supply and the local context
- Firms do not need to build all capabilities to be successful in certain GVC functions
- **Firms can have varying results on different capabilities and they are related.**
 - EX: a CMT apparel firm has less challenges with delivery time; product specialization affects labour productivity levels; type of buyers and number of buyers affects type of products and number of products
- **To build capabilities across all categories can even make firms uncompetitive**
 - EX: a firm may acquire design capabilities but not be able to use them in exports and remain a CMT or FOB firm
- **Building overall capabilities may not be the best strategy**, or be perceived as too costly or risky in particular local contexts
 - EX: in a country with no textile sector and land-locked, it is very risky to move into FOB
- **Need to analyse firm level capabilities in the context of firm's function within GVC**, product specialization, buyer relationships and local country structural and institutional contexts

Findings of the industry case study papers are
available in CAE Working Papers,
www.ruc.dk/cae