



## Technological catch-up in complex product systems<sup>1</sup>

Mehdi Majidpour\*

Department of Management, Science and Technology, Amirkabir University of Technology, Tehran, Iran

### ARTICLE INFO

#### Article history:

Received 25 August 2015  
 Received in revised form 17 July 2016  
 Accepted 28 July 2016  
 Available online 5 August 2016

#### Keywords:

Complex product systems  
 Catch-up  
 Regimes  
 Gas turbine  
 Iran

### ABSTRACT

This paper highlights distinctive features of technological catch-up in complex product systems (CoPS). This paper contrasts catch-up trends in CoPS with trends in mass-market commodity goods, such as those produced in South Korea. Developing countries are lagging behind in many CoPS areas and technological catch-up in CoPS industries is a very challenging process. This paper argues that due to specific technological and market regimes, the dominant model of technological catch-up in CoPS is based on path-following catch-up. Stage-skipping catch-up is only possible in minor technologies and path-creating catch-up is almost impossible in CoPS industry.

© 2016 Elsevier B.V. All rights reserved.

### 1. Introduction

Studies by Miller et al. (1995), Hobday (1998), Hobday and Rush (1999), Hobday and Brady (1999), Hobday and Davies (2005) and Dedehayir et al. (2014) promote CoPS as an analytical category that is different from the production paradigm of mass-market commodity goods. These studies identify CoPS industries as involving technology-intensive capital goods, systems integration, embedded and largely tacit knowledge and skills, project-based manufacturing, low-volume production (batch produced or individually tailored for specific customers), and concentrated and politicised markets with few buyers and few suppliers. Despite occasional radical technical changes at the component level, CoPS have long-term stability among systems integrators, and have long economic lives, lasting up to several decades (Hobday, 1998; Ren and Yeo, 2006). Furthermore, a substantial difference between CoPS and commodity product industries is that in the case of disruptive changes, the incumbent CoPS technology does not overshoot mainstream market performance demand (Dedehayir et al., 2014).

CoPS are the backbone of the modern economy and are now treated as a distinctive category for research and analysis (Ren and Yeo, 2006). Due to numerous and interconnected complex components, extensive supplier chain, high unit cost and large scale manufacturing, after sale and logistic issues, CoPS industries can create a considerable economic stream in society. Scholars have become in believe that CoPS counts an important indicator of industrialised development (Rosenberg, 1963; Acha et al., 2004). However, despite the importance of CoPS, the literature on technological catching-up is heavily based on evidence from mass-produced goods. The majority of catching-up studies have not been operationalised in CoPS industries. The catch-up literature has failed to help CoPS manufacturers in developing countries cope with challenges/difficulties such as managing acquisition of complex technologies, dealing with concentrated market of CoPS and managing

<sup>1</sup> Earlier versions of this paper have been presented in various places, including the High-level Knowledge Forum, October. 15–16, 2012, Seoul, South Korea; the Asia Pacific Innovation Conference (APIC 2012), October 13–14 2012, Seoul National University; and Frontiers in Development Policy Conference (organised by World Bank), 21–22 November 2013, Seoul, South Korea.

\* Corresponding author at: Department of Management, Science and Technology, Amirkabir University of Technology, Tehran, Iran.  
 E-mail address: majidpour@aut.ac.ir (M. Majidpour).

cross-project organisations. This is mainly because developing countries are lagging behind in many CoPS areas (Ren and Yeo, 2006) and the scholars believe it is difficult for latecomers to catch up with leaders in CoPS (Park, 2012). Even in the success line of East Asian firms in mass-market commodity goods, the evidence suggests their inferiority in CoPS industries (Abegglen, 1994; Choung and Hwang, 2007; Park, 2012). There is not any cases on the subject of space crafts, aircrafts, gas turbines, high speed trains, missile systems and etc. in the technological catching-up literature. The only existing catch-up case in CoPS describes technological development of Korean telecommunication system (Park, 2012); nevertheless, it has already been studied by Lee (2001) and Lee (2005) while it was not treated as CoPS. It is, nonetheless, interesting to compare catch-up trends in CoPS with trends in mass produced goods, such as those studied in the East Asian context, as these reveal different kinds of insights.

In contrast to Park (2012), this paper argues that in order to understand the difficulty of catching-up in CoPS, we need to focus on technological and market regimes of CoPS industries rather than their different life cycle shape from mass-produced goods. To explore these issues, this paper deals with Iran's land-based gas turbine (LGT) industry as a CoPS industry, and for the first time systematically examines the catching-up process of this industry in the context of a developing country. The evidence suggests that the Iranian company – MAPNA – is the only latecomer firm in a developing country that has fully localised LGT technologies and has expanded its markets to Middle Eastern and African countries (Majidpour, 2012).

This paper uses as a platform the South Korean model of catch-up introduced by Lee and Lim (2001) and Lee (2005). In this model, catch-up is analysed as following three different patterns:

- Path-following catch-up: catching-up firms follow the same path as that taken by the forerunners. However, due to historical experience, catching-up firms can go along in a shorter period of time than forerunners.
- Stage-skipping catch-up (or leapfrogging I): catching-up firms follow the path to an extent but skip some stage, and thus, save time. This happens when the trend of technologies is moving toward new trajectories and thus catching-up firms can take the advantage and reduce the gaps compared to forerunners. In this pattern, catching-up firms do not waste time and money with abolishing technologies.
- Path-creating catch-up (or leapfrogging II): in this pattern catching-up firms, after having followed the initial paths of the forerunners, take a risky and uncertain road to reduce its gaps with forerunners. It means that despite a dominant technology, catching-up firms go along with emerging technology, invest on this new technology as an alternative for dominant technology, and explore their own path of technological development.

The three patterns of catch-up are explained based on the forerunner firm as a reference point and use technological regimes to explore catch-up dynamics. Technological regimes of the industry – such as the cumulativeness of technical advances, the fluidity of the technical trajectory and access to external knowledge bases (Breschi et al., 2000) – determine catch-up capabilities. Technological regimes also play crucial role in the dynamic properties of the innovative process (Malerba and Orsenigo, 1993; Breschi et al., 2000; Castellacci, 2007). In the South Korean model, market regimes, to a certain degree, can be derived from technological regimes, and thus the analysis is more inclined towards scrutinising technological regimes.

The extent to which technological catch-up trends in mass-market commodity goods can be extended to CoPS industries is a complex question. Thus, it seems reasonable to pose two questions: what can be said about the appropriability of the South-Korean patterns of catch-up in CoPS industries? And, what particular features of technological and markets regimes of CoPS industries impede many latecomer CoPS firms from catching up with industrialised countries? This paper aims to answer these questions. At the outset, it must be recognised that this paper focuses on technological and market regimes of CoPS – as a new idea of analyzing technological catch-up in CoPS – and thus the level of analysis is the industry. However, due to interdependency of firm, industry and national level policies in the CoPS setting, this paper needs to consider government policies as well as firm's strategies to deal with catch-up challenges.

## 2. The conceptual framework

### 2.1. Technological catch-up

“Catch-up relates to the ability of a single country to narrow the gap in productivity and income vis-à-vis a leader country” (Fagerberg and Godinho, 2005). Discussions of the means of technological catch-up typically focus on the role of technology and innovation. The idea of technological catch-up discusses the narrowing (or widening) of gaps between the technological capabilities of firms and economies (Bell and Figueredo, 2012). From this perspective, the flow of knowledge from leaders to followers is the very essence of the catch-up concept. There have been numerous studies on catch-up processes, and a number of these studies have focused on the processes involved in technological catch-up. Among these contributions, Abramovitz (1986) emphasises the vital role of social capabilities in catching-up, Gerschenkron (1962) highlights the importance of mobilisation of social intent to undertake rapid development, and Cohen and Levinthal (1989) emphasise issues of absorptive capacity.

The emerging literature on catching-up is more inclined towards Gerschenkron's approach, which emphasises the variety of catching-up models and their roots, rather than presuming it to be a standardised process. Gerschenkron (1962) highlights indigenously developed policies for catching-up, and perceives the conditions of latecomer countries as different from one

Download English Version:

<https://daneshyari.com/en/article/5107778>

Download Persian Version:

<https://daneshyari.com/article/5107778>

[Daneshyari.com](https://daneshyari.com)