Longolá Marche Arrière! Chinese Diesel Engines on Congo's Inland Waterways

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Abstract

The comparatively cheap and mechanically accessible Chinese *dakadaka* diesel engines and their *shotteur* Z-drives have enabled wooden *baleinières* to significantly impact waterborne mobility, trade and transportation on the Congo River and its tributaries. While baleinières are artisanal watercraft made of local building materials, their engines are globally circulating technologies, which are able to unfold their economic, hydrodynamic and socio-technical affordances thanks to a number of local technical adaptations. On the basis of ethnographic fieldwork in Tshopo province (DR Congo) foregrounding the engines' use, the article discusses the adaptations the Chinese engines and their propulsion system undergo to enable a felicitous engagement of their intrinsic engineered forces with the muscular, natural, and social forces present in their local riverine habitat. While this entanglement of forces depends on the distributed character of collective onboard engine care, it also encourages the emergence of baleinière owners (*armateurs*) as a new group of local entrepreneurs.

These insights help us understand why, despite frequent breakdowns, the engines and the boats they propel enable, and democratise the access to, new forms of connectivity and mobility for large parts of Congo's riverine and travelling urban populations. In a context of enduring economic precarity, the technical gesture of 'removing the [engine's] backward gear' (Li. *kolongolá marche arrière*) is therefore also of metaphoric significance.

Keywords

River transport, diesel engines, baleinières, travelling technology, local adaptations, Congo River, entrepreneurship, mobility.

Heating up

> In the engine room at the back of the *HB La Princesse*. We are running with three of the four dakadaka engines. Engine four is right now being repaired. Last night, the new exhaust pipes were still glowing like red candles in the darkness, as we were pushing the baleinière and its load continually further upstream. After 48 hours of incessant service, and unlike marine Diesel engines that have a water-cooled exhaust manifold, the exhaust pipes have literally melted and fallen off. Only one is still attached, preventing the explosions from emerging like tongues of fire from the motors' bodies. The undamped clatter is weighing heavily on the ears of all those present, making verbal communication quasi impossible. All three running engines are new. Only the small 24-horsepower one to the left (let's call it M4) has already served before, on another baleinière. This is probably why it 'got tired' (Lingala: *elembi*), as the mechanics call the state when an engine has stopped working, hinting at its anticipated reawakening. Two of the three mechanics at work – both are namesakes called Alino – just started looking for the problem. M3, the engine's bigger 30-horsepower brother to the right, is powering the pump that sucks water from the river for its own and its little brother's cooling systems. A lot of dripping, spraying really, all around the engines, as if lubricating a wider aesthetic continuum between the mechanics' bare hands and feet, and the oily vibrating texture of the wooden planking of the boat. We are on our way back to Kisangani, on the upper stretch of the navigable Congo River, where the *Bend in the River* signals the end of navigation at the Wagenia falls.[1]

Ever since their first arrival in the late 1990s, Chinese *changfa* Diesel engines have had a profound impact on waterborne mobility, and thus on local trade, on Congo's inland waterways, and across the Congo basin. Onomatopoetically referred to as *dakadaka*, the engine is a horizontal, mono-cylindrical, stationary engine, renowned for its role in the mechanization of agriculture in China and South Asia. Also in Congo, its reliance on V-belts enables it to power all sorts of machinery including welding workshops, cassava and corn mills, sawing mills, rice threshers and water pumps. Aboard of baleinières a V-belt connects it to a Z-shaped stern drive transmission system, similarly of Chinese

[1] Engine ethnography of 9 November 2017, on the inaugural journey of the HB La Princesse, on its way upstream from Isangi back to Kisangani. *A Bend in the River* is the title of V.S. Naipaul's novel first published in 1979 (New York: Alfred A. Knopf), and set in the city of Kisangani.

make and locally called *shotteur* (after the German propulsion maker Schottel, see below). Despite the engine's impact on waterborne mobility and on the mechanization of agriculture in contemporary Africa more generally, it has so far received hardly any scholarly attention.[2]

In the DR Congo, two brands of Chinese stationary engines compete with each other. *Changfa* are imported via East Africa, and the *moteur Poussa*, and named after the Kinshasa trading house where it is sold, reaches Congo in containers via the port of Matadi. The differences between the two do not exceed variations in colour and design. Their model range, construction plan, injection system and cooling system are identical, with the models S1115/ZS1115 (24 hp) and S1130/ZS1130 (30 hp) being the preferred ones on baleinières, where between two and seven of them are nowadays installed in a line at the stern.[3]

Hopper cooling being the most elementary form of evaporative cooling, preceding air cooling and closed-circuit water-cooling concepts, the dakadaka engine is indeed the mass-industrialized version of one of the oldest forms of the internal combustion engine. Its current success in Congo strikingly exemplifies David Edgerton's argument in *The Shock of the Old* (2006) that the history of technological change, if measured by actual usage rather than an innovation's promise, is much less linear and driven by novelty than it is sluggish, cyclical and often in keeping with the

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[2] But see the work on the Ghanaian mining sector, where the same engine powers so-called *changfa* machines: stone crushing devices named after the engine's Chinese brand name (Bansah 2016; Botchwey et al. 2019; Cabada Rodriguez 2017). The *changfa* engine is also used by gold miners in Eastern Congo, who use it to power air and water pumps for diving and dredging (Simon Marijse, personal information).

[3] Models available in DRC are the S195/ZS195 (815cc, 13 hp, 145 kg); S1100/ZS1100 (903cc, 20 hp, 155 kg); S1115/ZS1115 (1195cc, 24hp, 195 kg); and S1130/ZS1130: 1595cc, 30hp and 230 kg).

old.[4] In a time of digital and smart technological sophistication, how can we explain the overwhelming success of Chinese low-tech of feeble solidity, at work in geographical and operational domains that are both unrelated to its initial prospect?

To answer this question, this article has found inspiration in the frameworks of methodological fetishism (Appadurai 1986: 5) and affordances (Gibson 1986, Faraj and Azad 2012), allowing us to attempt ethnography by placing the engines and their putative agency as protagonists in the centre of our attention.[5] Methodologically, next to semi-structured interviewing and participatory immersion in the field, the research has required to attempt ethnography 'from the engines' point of view'. The resulting 'engine ethnography' was collected on and around the shippable waterways in and downstream of Kisangani in the province of Tshopo (DR Congo), during four months in 2015, three months in 2017, two months in 2018 and two weeks in 2019.[6] Interviews

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[4] Evaporative cooling technology was first patented in the United States in 1922, after a phase of pioneering work by Muir (Jafari et al.: 1131). The fact that the engine is currently produced and sold in China at a rate of ca. 1,5 million a year, underscores Edgerton's argument.

[5] Following the evolutionary psychologist Gibson's (1986) reflections on the ways in which humans learn to engage with their environment, the affordances concept allows us to capture how things and actions entail each other, i.e. how things encourage and engender human action and interaction. An object's affordances can be seen as the potentialities it holds for a particular set of actions, which it incites in humans, for instance through its suggestive design and haptic character. The concept thus helps us think 'from the engines' point of view'. It lends itself to our use-centred 'engine ethnography' as it captures the mutual encouragement and conditioning of humans and things through their external forms and workings, without simply postulating in ANT fashion that they are agentive hybrids.

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and multiple *causeries* have been conducted with various actors surrounding Congo's baleinières and river worlds, including traders, boat builders, boat owners, mechanics, crew members, passengers, state agents, and, yes: engines.

Previous anthropological work on transport-related technologies in Africa has stressed the importance of technical adaptations for the local success of globally circulating technologies. Existing studies have focused on British Bedford trucks being turned into *Sifinja* 'iron brides' in North Sudan (Beck 2009; Hänsch 2009); the conversion of a German ambulance into a *tro-tro* taxi bus in Accra (Beisel and Schneider 2013); the joint trajectories of the long-distance driver Kwaku and his Peugeot 504 car in Ghana (Verrips and Meyer 2001); and the repair and adjustment work of Indian auto-rickshaws in Kairo and Kinshasa (Tastevin 2011, 2012). The case presented here differs not only in its focus on waterborne mobility, thus departing from the subtle road-bias in the social study of transportation. It also lends insight into how two previously unrelated technologies, one artisanal and the other one industrial, intertwine and co-shape each-other in a seemingly symbiotic association.

Moreover, internal combustion engines (ICEs) in Africa remains strikingly understudied. With anthropology having been preoccupied with other, often less material, issues at the time when diesel engines became widespread after World War II, and despite their crucial role for projects of agricultural mechanization, it is most likely the recent fascination for, and the impact of, digital and 'smart' technologies (mobile phones, internet, etc.) that explain why 'hard' technologies such as engines remain the somewhat forgotten heroes in the backroom of scholarly attention (but see Gewald et al.

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2009, Gewald 2015, and Larkin 2016). The crucial exception is Kurt Beck's long-term study of the social and technical domestication, i.e. the 'taming' (Ger.: *Zähmung*), of the diesel engine for irrigation purposes among the Manâsîr on the Nile in North Sudan. In only two decades (ca. 1955-1975), water pumps powered by Lister engines of British and later of Indian make, came to outdo and supplant the traditional oxen-powered Sâqiya waterwheel, with major consequences for the local agriculture and demography (Beck 2002, 2012; see also Verne et al. 2017). Though it is too early for a conclusive evaluation, the impact of the changfa/dakadaka diesel engine in DR Congo is significant. As this article shows, in the field of river-based transport alone it has had a powerful democratizing effect on the access to transportation: if beforehand traveling on the River was cumbersome, unpredictable and geographically limited, dakadaka powered baleinières have allowed large segments of a rapidly growing local population to travel to hitherto unreachable places, with unprecedented frequency and with exceptional economic consequences. The same is true for the access to owning a transport vessel, and thus to the considerable dividends transportation generates.

The first part offers a geographical and historical background to baleinières and their impact in the DR Congo's Tshopo province. The second part considers the engines' economic trajectories as commodities from China that are imported and distributed by Congolese traders. Thanks to their successful association with Congo's baleinières, local *armateurs* (baleinière owners) have started emerging along Congo's navigable waterways as a new socio-economic group of patrons. The last two parts are dedicated to the technical adaptations of the propulsion system. Part three presents the engines' hydrodynamic advantages, which are made to unfold by spatially, and thus socially, 'spreading out' the propulsion system and its steering mechanism across the engine room, with the effect of a horizontal distribution of labour. Part four discusses the modification of the dakadaka's cooling system and the removal of the backward gear, which enable the engines to engage with, and make use of, the forces of the River. It appears that their efficiency is less the result of material and technological sturdiness than of technical adaptations that lend the engines the decisive affordance of intertwining and mobilising muscular, natural and engineered forces to its own operational benefit.

[Figure 1 near here: Baleinière in Isangi, Tshopo province (DRC), November 2017 (Foto by author)]

Congo's *Baleinières*

At the crossroad of Swahili speaking East Africa and Lingala speaking West Central Africa, Congo's fourth biggest city Kisangani is known for the Wageniya Falls (formerly Stanley Falls), which prevent watercraft from navigating further upstream. Here, some ways end while others begin. It is a place of arrival, limitation and remoteness, yet also one of departure, imagination, and connectedness. Long before colonial times, Swahili traders and their caravans connected this region to the Indian Ocean (Northrup 1988). Later, it was here that goods arrived by railway from Ubundu (ex-Pointhierville), or by truck on the two roads from the East, to be trans-shipped onto a barge and travel down on Zaire's 'national highway' (the Congo River) to Kinshasa and, eventually, to the Atlantic Ocean (Pourtier 1993).

In Kisangani, the Congo River runs like an ever-moving lake through the city. On either side, Belgian colonialism has left behind four industrial cranes, which together form the *singa mwambi*, the iconic 'eight strings',[7] as Kisangani is also called, remembering the industrial scope of the city at the heyday of the *voie nationale*. Today, since the 'national highway' is no longer used to evacuate Congo's minerals, 'if one out of eight cranes is used for more than an hour a day, it is a lot.'[8] With the collapse of the national economy in the 1990s and the subsequent Congo Wars (1997-2003), Kisangani and its ports entered into an economic slumber with only occasional arrivals and departures of a pushboat-barge-convoy to or from Kinshasa. This changed when in recent years, an ever-growing number of wooden *baleinières*, powered by Chinese propulsion systems, started reverting this economic hibernation period, to the benefit of the more local, short-distance, economy.

With its ca. 25000 km of navigable waterways, the Congo Basin is among the world's largest areas with an inland shipping potential. In the 16th and 17th centuries, the Lower Congo's cataracts prevented European explorers from entering the River further than Matadi. Upstream trade in slaves and ivory was in the hands of waterborne Bobangi traders, whose mobile activities relied on large dugout canoes, and who established Lingala as the koine of the River (Harms 1981). Colonial and missionary endeavours at the times of the Congo Free State (1885-1908), relied extensively on waterways for exploration, as means of communication and for the evacuation of goods and people. With the Congo Free State transforming into a Belgian state colony in 1908, large-scale infrastructural investments ensued. On all rivers deeper than one meter during the shallow period, a network of primary and secondary ports was installed with

[7] In the popular opinion this expression is also linked to local women's overpowering ability to 'tie down' (Li. *kokanga*) visiting men with the ropes (Li. *singa*) of their charm.

[8] Personal communication, Albert Henri Buisine, Kisangani, August 2017.

an assorted fleet of steamers and barges. The Belgian Congo's waterways became an internationally renowned laboratory for the newest shipping technologies, allowing Rudolf Diesel and Belgium's king Albert I to personally discuss the advantages of the Diesel invention: consumption, cost-effectiveness, and safety (Lederer 1965: 175). By 1955, Diesel powered riverboats propelled by a ship screw outnumbered those with a stern wheel powered by steam (Jacobs 1956, Lederer 1965: 286-287). In 1960, 73,5 % of floating horsepower on the Congo River had been 'dieselised' (Huybrechts 1970: 41). Passenger-friendly Integrated Tow Boats (ITB) served as courier boats on the lines Kinshasa-Kisangani and Kinshasa-Ilebo. In addition, a variety of pushboats with barges for goods only served a variegated network of fluvial destinations. Differing in power, capacity and draft, they were adapted to serve the respective category of waterway in concordance with its seasonal shippability. In post-colonial times, this national fleet saw itself gradually privatized by Zaire's president Mobutu and his generals. With the economic crisis of the country deepening in the 1990s, the lack of maintenance and reinvestment gradually caused the downfall of the *Office National du Transport* (ONATRA) and its state monopoly, with a large part of its fleet having sunk or stopped being operational. Cynically, this occurred at a time of increased necessity for transportation due to demographic growth and rapid urbanization.

Figure 1. Baleinière in Isangi, Tshopo province (DRC), November 2017 (Foto by the author).

In the absence of an operational steel plant in the country, local craftsmen took to responding in their own ways to this scenario of urgency, by assembling skills, materials and social configurations that had gathered in the toolbox of Congo's history.

Thus, baleinières grew out of 'the folds'[9] of Congo's transport history so as to offer a viable solution able to confront the economic, geographic and social challenges of a new situation. While food security specialist Eric Tollens estimated in 2003 that baleinières accounted for at least 40 % of the transportation of all incoming edibles in the city of Kinshasa, their impact has rapidly grown in recent years, with an increasing number of local entrepreneurs having reached the marginal point of capital accumulation necessary for investing in a baleinière. This growth is particularly visible in the ports of Kisangani, where in 2017 thirty-four baleinières arrived and departed from its ports during the month of October. By 2019, this number had risen by about forty percent (Lambertz and Yaaya forthcoming). Though often ridiculed because of their artisanal nature, their at times rudimentary apparel and their reputation as *cercueils flottants* (floating coffins) due to multiple accidents, baleinières are today indispensable for the food security of many of Congo's cities, towns and villages, especially Kinshasa, Mbandaka and Kisangani.

The concept of 'baleinière' is a lexical atavism referring to the ca. nine-meter-long steel 'whalers', which, in the early days of colonialism were crafted in Belgian steel factories, shipped in pieces to Matadi, and then carried to Leopoldville (today's Kinshasa), where they were re-assembled to provide for reliable watercraft that could be propelled with local manpower. These boats were used to transport goods and people, and to explore the Congo's vast network of waterways. Other than their name, however, today's *baleinières* have nothing in common with their historical ancestors: they are entirely hand-crafted, self-propelled, and have grown up to fifty meters in length.

[9] Expression by Yann Philippe Tastevin in his paper 'Les tribulations africaines du rickshaw indien', presented at the IHA-CREPOS programme, Dakar, 5 april 2018.

Moreover, their design mimics proper crusade ships and has little in common anymore with the original 'whaleboats'.

In its initial and still predominant material composition, the Congolese *baleinière* was conceived by André 'Bibeyi' Mafisango (1925-2015) in the town of Nioki on the Mfimi River (Mayi Ndombe province) in the late 1950s. It is here that knowledge and skills of the forest and its products, colonial logging, wood milling and carpentry, and the riverine world of fishing and waterborne mobility encountered each other. André 'Bibeyi' (Lingala for *barge*), combined the ship design he had picked up from his Belgian master at the Forescom logging mill in Nioki, where he had worked as this carpenter's apprentice, with exclusively local building materials. Contemporary *baleinière* builders (*ingénieurs*) remember him as the charismatic and talented inceptor of their craft, and hence the common ancestor of their profession (cf. Lambertz forthcoming a). Bibeyi chose to craft baleinières out of *tola* wood (*gossweilerodendron balsamificerum*), whose feeble density lends the boat an impressive floatability. In recent years, this has enabled the development of novel periodic markets at portless bays on upstream secondary rivers (Takamura 2015), where larger barges made of steel are unable to moor. Local fishermen know *tola* as the wood of their dugout canoes (Li. *bwáto*). Other building materials include nails and recycled, corrugated aluminium rooftops. Together with the waterproof *kassa quanga* leaves, flattened and cut up aluminium sheets are used to seal the slots of the planking, which, unlike proper caulking, have previously been filled with *mastique* made of tar and sawdust composite.

The latest generation of baleinières being built in Kisangani are nowadays fifty meters long. This is nearly twice as long as the baleinières that circulate between Kinshasa and the Mai Ndombe and Kwilu provinces. While the latter follow the simpler style invented by André Bibeyi more closely, in Kisangani it is not rare to see baleinières with up to ten cabins and three full-length storeys. Three factors explain this development in style and size at the upper end of the navigable Congo.

Firstly, with the road towards Butembo and Kampala being restored in 2015, fuel started arriving in large quantities from East Africa in large trucks run by Somali traders from Kenya. In Kisangani, a large part of this fuel is transferred into blue plastic barrels, which are loaded onto large *baleinières*. The latter ship them to places as far as Binga and Businga on the Mongala River (at ca. 900 and 950km from Kisangani, respectively) and Mbandaka (ca. 950 km). Hence, it is from Kisangani, and on baleinières, that most places in the equatorial forest nowadays receive their fuel. Undoubtedly, Kisangani's upstream location, where road and River meet, and the advantage of having to carry bulky barrels downstream, has encouraged the upsizing of *baleinières*. Secondly, the upper Congo River between Bumba and Kisangani is host to two different styles of baleinières. It was in Isangi (ca. 120 km downstream from Kisangani) that in 2007 boat builders from the island of Idjwi in lake Kivu arrived. Until today, they propagate a different architecture most probably inherited from the *dhows* of the Indian Ocean that perpetuates itself in the Great Lakes' wooden *bottes* (from English: boat). When in 2009 the Nioki style reappeared in Kisangani with the advent of André Bibeyi's son Mafi, an engineering race started between the two styles, causing younger building apprentices to generate a seemingly entirely new generation of *baleinières* (Lambertz forthcoming a). Thirdly, all this would, however, not be possible without the propelling power of the Chinese changfa / dakadaka engines and their shotteur Z-drive transmission.

Before exploring this latter factor more in depth, the following section presents the Chinese engines' arrival and circulation in Congo's water worlds, as commodities from China that are imported and distributed by Congolese traders since the early 2000s. The successful crossing of the engines' and baleinières' technological trajectories accounts for the emergence of a new group of local entrepreneurs, whose success is thus inextricably linked to the Chinese engine.

Engines and Owners

While the origins of stationary Diesel engines with evaporative cooling go back to the early years of the Diesel engine in the 1920s (Jalfari et al. 2017: 1131), its current presence on the world market is due to its success and popularity in rural China. The operation manual of the S195 I received from a local engine seller in Kinshasa proudly notes its origins as 'Made in the People's Republic of China' in big capital letters on the cover page. The introductory passage of the booklet informs us about the engine's versatile applicability:

> 'S195 Diesel, is a horizontal type, single-cylinder, four-stoke, water evaporative cooling engine, having the advantages of light weight, compact construction, easy transport, simple installation, little vibration, smooth running and sasy [sic] maintenance. It is suitable for powering walking tractors and for driving agricultural irrigation and drainage pumps, as well as other agricultural processing machines such as threshers, huskers, grinders and forage pulping machines. It can also be used as a prime mover for small electrical generators, air compressors, small river ship-propulsion and moter [sic] vehicles' (p.2.).

Before more sophisticated multi-cylinder engine technology was imported to China after 1978 (Yuan 2005), in the 1970s and early 1980s single-cylinder diesel engines were the only available small engines in China. Along with tractors, hand-tractors, tractor attachments, irrigation and drainage equipment, they were mass-produced by different companies as part of the government's push to mechanize its agricultural sector. Originally designed for stationary agricultural machinery, they were widely used to power walking tractors (Sperling et al. 2004: 14) before becoming the standard engines for low-price three and four wheeled ^ (CRVs). As research on CRVs has shown, many of China's counties had their own single-cylinder factory. A single province could have tens of such factories (Sperling et al. 2005: 109), which gradually transformed into full-scale businesses.[10]

The pragmatic advantages of versatility, small size and weight – I have myself observed a single person carrying an entire engine up a baleinière –, combined with efficient fuel consumption, easy maintenance and limited technical complexity, explains its important role in the mechanization of agriculture in China itself, but also in Bangladesh, Sri Lanka and Nepal. Here, it undercut the price of comparable Japanese equipment by over half. In these latter countries, despite its '(l)ower quality Chinese equipment turned out to be 'good enough' to meet the basic economic and technical needs of small farmers with small fragmented plots (…)' (Biggs, Justice and Lewis 2011: 79). Especially Bangladesh is of interest to our topic, as here, alongside the introduction of two-wheel tractors in the 1980s, river transport also mechanized rapidly by the same engines imported from China (Biggs and Justice 2020: 13).

Figure 2. Dakadaka engine with shotteur on a local dugout canoe (bwátu), Kisangani, August 2017 (Foto by the author).

[10] This is due to China's specific economic history (closure to outside investments and technology, steady economic growth from the 1970s onwards, large population, policies regarding Chinese Rural Vehicles (CRV)). Thus, China appears to be 'the only country in the world with a large rural vehicle manufacturing industry' (Sperling et al. 2004: 8)

The DRC is currently the recipient of two Chinese engine brands: *changfa*[11] and *Poussa*, the latter being the local name of the local sales branch in Kinshasa, which is printed onto the engine.[12] Given the latter originates in the same factory that produces the 'propeller' (shotteur), *Maison Poussa* holds an informal monopoly on shotteurs in the country. The dakadaka engine first arrived in Kinshasa as an experimental import by Mr. Ying, a Chinese trader, in 1997. At a time when the DRC was in the middle of one of its fiercest political crises – the Congo Wars (1997-2003) had just erupted – Ying hoped for profitable business in a high-risk environment. His initial plan was to specialize in fabricating and selling glass, but he soon noticed the absence of affordable technologies for the mechanization of agriculture, as he knew them from China. Ying soon founded his own sales company for Chinese agro-tech in Kinshasa, which continues to flourish till this day under the name 'Maison Poussa' (*kopoussa* being 'to push, to move on' in Lingala). Before entering the realm of boat propulsion, the dakadaka engine was mainly sold along with electric generators, e.g. for welding workshops, or to power rice threshers and cassava or corn mills. According to one of Ying's company's oldest employees, the impulse to couple it with the Chinese 'shotteur' Z-sterndrive, and place it aboard a baleinière, was indeed Mister Ying's personal initiative.

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[11] The 'changfa Group is a large diversified industrial conglomerate mainly engaged in properties industry and manufacturing industry of agricultural machinery and refrigeration equipment. (Its) (h)ead-quarter is located in Wujin District, Changzhou City.' http://www.changfa.com/english/about/index.html, last accessed 17.04.2020.

[12] The company's website informs us that 'Changzhou Machinery & Equipment Import & Export Co., Ltd. (AMECCO), founded in 1983, is the core member of Changzhou AMEC Group, and the only hub and outlet of AMEC Group for its overseas marketing.' http://www.amecco.com/about1.php , last accessed 17.04.2020.

Very early in its Congolese career, the technology left its Chinese custody and started unfolding a proper Congolese biography: carrying on the first experiments initiated by Mr. Ying, one of his employees, a mechanic from Bandundu province who knew the River well, developed a chassis system on which several engines and shotteur Z-drives could be lodged at the stern of a wooden baleinière. Some years later, a Congolese trader from Kinshasa expanded the trade across the country, specialising the selling of shotteur Z-drives. Today this commercial network spans directly from the engine and propeller factories in China to four different shops in Congo's most important river-based commercial centres (Kinshasa, Kisangani, Businga and Nioki), with options for further expansion to Ilebo on the Kasai River currently on the hold.[13]

Baleinières' and their engines' trajectory to upstream Kisangani differs. After a first pioneering mission of one baleinière builder from Nioki to Kisangani in the early 1990s, building was interrupted here during the Congo Wars, leading to a relatively late reintroduction of baleinières upstream of Mbandaka only in the mid-2000s (Lambertz forthcoming a), with the dakadaka engine arriving in around the same time. Local mechanics pertain that its first appearance in the upper Congo region occurred in Bumba, where old mechanic Manzomba and his son Olivier are commonly credited for having been the first ones to install a dakadaka engine on a traditional dugout canoe (*bwátu*).

[Figure 2 near here: *Dakadaka* engine with *shotteur* on a local dugout canoe]

[13] Data as of 2018, when Congo's upcoming presidential election was foreshadowed by political and economic uncertainty.

The far-reaching and very frequent ‘dakadaka’ sound of such diesel-powered canoes proves the striking success of the innovation. While it seems undisputed that it was the Manzombas from Bumba who indeed first installed a dakadaka on a canoe, Manzomba Jr.’s claim that it was him who started using the engines aboard of baleinières,[14] appears valid only for the upper Congo at best. More realistic seems an introduction by boat builder Mafi, who started working in the area in 2009 when commissioned by sister Madeleine Bofoe from Isangi. It was her, who first shipped three ‘Poussa’-engines from Kinshasa to be placed on Mafi’s first upstream construction in Isangi.[15]

Kisangani being located geographically, economically and culturally, between East and West Central Africa, the engine’s commercial trajectories in Kisangani differ from the one in Kinshasa. If in the heyday of Zairian nationalism, the vast majority of manufactured products sold here were shipped upstream from Kinshasa, nowadays at least 50% arrive from Kampala in the East. The Eastern trade networks are in the hand of Nande traders from the area of Butembo (MacGaffey 1987, Raeymaekers 2014). Their expansionist and locally somewhat ill-reputed economic protectionism not only explains why, to the difference of Kinshasa, there are no Chinese small-scale shops in Kisangani. It also explains why it is Nande traders, who import and sell changfa engines.

[14] Interview, Olivier Manzomba, Kisangani, 04.12.2017.

[15] Before Mafi’s arrival in 2009, it was sister Madeleine who had, at first, invited boat builders from Idjwi (lake Kivu) to come and exercise their craft in Isangi on the Congo River, allowing her and her congregation (the *Filles de la Sagesse*), to mount a fleet of four Idjwi style baleinières called *Arche de Noé* I-IV. Interview, Soeur Madeleine Bofoe, Isangi, 21.09.2017. Despite the crucial role of a woman in the launching of the first baleinières on the upper Congo, armateurs, ingénieurs and crew members are today all men.

Historically speaking, Nande traders reactivate the geographical connection once established by East African Swahili traders. Hence, poussa engines, which are shipped upstream from Kinshasa, compete here while *changfa*, which are imported by Nande traders in containers from the East, via their personal family connections in China and Dar es Salaam.[16] While this applies only to the engines and not the shotteur Z-drives (see above), this economic competition secures the engine's affordable and relatively stable price of approx. 750 and 900 USD for the S1115 (24 hp) and S1130 (30 hp) models, respectively.[17] Beyond the impact of Chinese engines in these trading networks, their socio-economic impact is most visible in the emergence of a local class of baleinière owners (*armateurs*), which actually challenges Janet MacGaffey's (1981) older findings about the virtual impossibility for local small-scale capitalists to accumulate sufficient capital to start their own business. The following two biographical cases exemplify this socio-economic development:

Jean-Pierre (33) is the owner of the baleinière *HB La Princesse*. He and his cousin Ben (36) are both the proud owners of three running baleinières. Both are from Isangi (ca. 150 km downstream from Kisangani) and identify as Lokele, the local ethnic group known for its affinity with fishing, the River, and waterborne mobility. Long before the era of baleinières began in this part of the country, Jean-Pierre and Ben grew up as small-scale traders, moving up and down between Isangi and Kisangani, either as trading passengers aboard of outboard-engine-powered canoes (*pirogues motorisées*), or with their bicycle on the road next to the River, or both (upstream on the road, downstream on the water). They soon specialized in the trade with pigs from their own

[16] Personal information from a Nande trader, Kisangani, September 2019.

[17] Kisangani prices as of September 2019.

family pig sty in Isangi, which they exchanged in Kisangani for spare parts for Chinese motorbikes. Gradually they managed to acquire these spare parts directly, first from Butembo, then straight from Kampala. Jean-Pierre was 26 when, under the economic guidance of his Baptist pastor, he managed to accumulate sufficient capital to purchase one of the first baleinières that had been built in the region, from sister Madeleine Bofoe in Isangi. Both being of a humble background with initially little perspective to become actual *patrons* themselves (as MacGaffey has amply shown), thanks to motorbikes and engines from China, they today pride themselves in being the husbands of two and three wives, with six and seven children, respectively. Ben, reputed among crew members (*équipage*) for being a responsible and generous *patron*, is currently building a two storeyed house in the heart of Kisangani, with ten separate flats he is planning to rent out.

Jean-Pierre's and Ben's story is exemplary for a wider trend in the region. In the months of October and November 2019, a total of sixty-five baleinières have circulated in the ports of Kisangani, belonging to a total of fifty-five different owners, all of whom are Congolese with, in the vast majority of cases, a similarly humble, small-scale, trading background. In most cases, the connection (*ligne*) their baleinière assures in a weekly (Isangi), bi-weekly (Basoko, Opala, Bumba) or four-weekly (Bumba, Binga, Businga) rhythm from Kisangani, reflects the often kin-related socio-geographical background of their upbringing. Thus, owing to the dakadaka-powered baleinières, an intermediate entrepreneurial class of local *patrons* has been growing among local traders, indeed suggesting the dawn of a new chapter in the social, economic and also technological history of the DR Congo. The accusations of human sacrifice through occult manoeuvring that owners have to face in the case of an accident indicate, however, the problematic nature of their economic success (Lambertz forthcoming b). Unlike the horizontal and communitarian atmosphere among crew members and passengers aboard of baleinières, the armateur's privilege over the boat's dividends cause jealousy, ill-will and tensions, especially among *armateurs* themselves. This strikingly contrasts with the successful 'taming' of the diesel engine by Manâsîr farmers on the upper Nile, who have managed, over the years, to integrate the engine into their preexisting social organization of corporate land ownership and water distribution (Beck 2002, 2012). While the dakadaka technology is still too new for a sound overall evaluation, the violent legacy of Congo's extractive and exploitative historical experience does not render the 'taming of the machine', as Beck (2001) calls it, a most likely and easily achieved scenario.

The success of Chinese Diesel engines on Congo's waterways is not the result of successful marketing and distribution strategies. Neither does a symbolic connection with novelty, progress, with a particular kind of 'modernity' or any other symbolic surplus account for their local commodity value. On the contrary, given the generally ill-reputed noise of the engines, and because of baleinières' frequent accidents, dakadaka engines and baleinières more generally are connoted, for many, with regression and backwardness. This is particularly noticeable among the class-conscious few who identify through a-(n often nostalgic) higher-up-ness in Congo's kinetic hierarchy. The vast majority of armateurs, however, just like most of their crew and passengers, have not had the privilege to travel by plane or in their personal car. In the face of the intense precarity many unwillingly face, what matters to most is that the engines work rather than their connotation with ideas of progress or futurity. Though owners like Jean-Pierre or Ben frequently complain that 'ebebisaka mbangu' (Li. they break too rapidly), as is the general reputation of mist Chinese things,[18] armateurs discreetly rejoice in the face of their engines' low price and the security advantage of diesel as opposed to explosive gasoline fuel. The benefits clearly outweigh the costs, and the engines' commodity value is really determined by their pragmatic utility. Hence, among their local trading clientele they are proudly celebrated as true, and new, economic *bakonzi*, or: *patrons*.

The spread-out engine

Differing from their colonial namesake, today's baleinières are self-propelled watercraft with autonomous motility. Earlier versions of Bibeyi's innovation were powered by fuel-driven outboard motors known from the makes of Yamaha, Johnson, Mercury, etc.. Hence the prefix of their name being 'HB' for *hors-bord* (outboard). At the time of the dakadaka being the exclusive choice, this prefix seems obsolete, because dakadaka engines are really fixated onboard and cannot be easily detached. That baleinières have not started carrying the prefix 'MB' (*moteur à bord*) is due to a certain ambiguity linked to the appearance of the propulsion system as a whole: in the case of an actual 'MB' vessel, the transmission shaft (*arbre*), connecting the engine to the screw, pierces the hull at the lower bottom of the stern, rendering the propulsion system invisible. In the case of baleinières' dakadaka, the wooden hull does not have to be pierced, as the propeller is connected to the engine by means of a Z-shaped transmission system. The latter is externally attached, which, indeed, makes the engine resemble an outboard engine.

[18] Ben, for instance, once asked me if I could not find him a number of more sturdy engines in Europe.

The Z-drive component is also of Chinese make. Across Congo's river worlds it is commonly known as 'shotteur'.[19] This denomination symbolically inscribes the technology into an older trajectory of Congolese shipping-history. On the box in which this device ships from China, its name is, somewhat unspectacularly: 'propeller'. While this does not seem to have inspired the Congolese naval lexicon, *shotteur* is the local pronunciation of the historic German Z-drive maker Schottel, a century-old family-business based in the village of Spay on the Rhine. A Chinese technology is named here after the brand of a German product. All seems to indicate that this coincidence goes back to the ferry boats (Fr./Li. *bac*) the German Federal Republic (RFA: République Fédérale d'Allemagne) had offered their Zairian partner country of the capitalistic bloc in the 1980s and 1990s. These *bacs RFA*, as they are known still today, were all equipped with original rotatable Schottel Z-drives. The original Schottel system became notorious because of its rotatable screw, which is an obvious advantage when navigating a weighty ferry to and fro a powerful river. The Chinese shotteur lacks the advantage of the rotatable Schottel drive, but the recycling of its name indicates the extent to which it is also symbolically appropriated into the local social life of shipping technology in Central Africa.

> A dugout canoe (*bwátu*) has docked to my right, with a man and a young boy lifting *kwanga* cassava rolls into a green plastic basket placed on board. The man in his blue polo shirt is standing upright in his canoe, thus blocking the sight of the *commandant* (also called *chauffeur*) to my left, who heavily gesticulates for the man to move out of his sight. He seems to be shouting, but though I am sitting hardly two meters away, the engines are too loud for any human voice to reach my ears. At least ten times now has he moved his

[19] Some also refer to it as *pied* (Fr.: foot) that executes the orders of the superior *muteur* (from *mutú*: head). Pluralized as *miteurs* (engines, form *mitú*: heads), this term is the lingalification of the French *moteur* and can be seen as a symbolic appropriation of the Chinese technology. Alternatively, is it really so surprising that the longitudinal propulsion system of a baleinière, whose body parts are named after human body parts such as *mukongo* (back), *libumu* (tummy), *mipanzi* (ribs/walls), *mutú* (head), and *masoko* (buttocks) would be called its leg or foot (*pied*)?

gesticulating arm, with a sense of real urgency, each time rapidly rushing it back to the stick that transmits the force of his body to the rod that leads up to the rudder at the bottom of the shotteur. This steering system has been designed by local mechanics so as to increase the leverage of the rudder against the forces of the current, and in order to share this exhausting task with other members of the crew. In the absence of a hydraulic steering aid, especially when one of the engines is 'tired', the helmsman has to pull or push incessantly, in an act of counter steering to compensate for the asymmetric thrust.

[Figure 3 near here: Engine room of the HB Grace à Dieu 2]

In the front, where passengers sit and chatter, some are now eating the *kwanga* roll they just bought. Down below, in the belly (*libúmu*) of the boat, Alino II and one of the stewards are pouring gasoline from a blue 200 litre plastic barrel into a green bucket – the bucket I used in the morning to take a shower in one of the two washrooms behind the engine room at the 'buttocks' (*masóko*) of the boat. To stop and mellow down the flow of gasoline, Alino II stuffs his entire hand into the barrel's narrow opening. From the bucket, they now pour the gasoline on into a yellow plastic jerrycan (*bidon*), locally known as a container for vegetable oil, palm oil or water. The mechanics seem to experience a kind of professional tactile satisfaction when touching, pouring and spilling these oily liquids. Not just a few drops, but at least a litre I guess, have landed on the floor.
The father and his little boy are now returning with their plastic basket empty. The father climbs back into the canoe across the reeling next to me. The boy climbs in, but at the front of their canoe. The father places some *kwanga* rolls onto the *baleinière* and climbs back on. Again, they walk back over to the front deck, to sell a second round.
Below, a fourth *bidon* is being filled with gasoline. One passenger wearing big, red headphones, is watching how the thick liquid runs into a black funnel. Alino I is now also on the stairway. The band-aid I had given him to cover the wound on his left foot has soaked with oil and fallen off.
[…] All engines are running. Michel, who has taken over the steering rod, gesticulates to Nono, he should help him pull the steering rod, which he does by pushing it with his foot. Clearly, steering this boat takes a lot of physical strength and social interaction. An old paint pot (3 litres) hangs on a blue nylon rope and serves to lift water out of the river, for the toilet. Yesterday (at least), it was used to fill the bucket that was used today for diesel.[20]

[20] Engine ethnography of 9 November 2017.

Figure 3. Engine room of the HB Grace à Dieu 2. Isangi – Kisangani, September 2017 (Foto by the author).

The original Chinese steering rod (*guide*) is too frail to withstand the forces at work when steering a 40m long baleinière up the world's second biggest river. Its locally crafted replacement is one of the several important technical adaptations. It connects all the rudders and makes them steerable by one single helmsman, who frequently has to shift between the seats on either side of the engine room to make sure he can see enough. It also enables the mechanics at work in the engine room to physically assist the helmsman by weighing in with their own muscular force in the case of a hefty steering manoeuvre, or when counter-steering becomes necessary after one of the engines gets 'tired'. Successful propulsion is enabled here by the entanglement of muscular and engineered forces in order to tackle those of the River.[21] The sharing of the muscular effort also points to a distribution of labour across the ranks, flattening the labour-related hierarchies well-known from the world of (post-)colonial navigation. This communitarian spirit, omnipresent on Congo's baleinières, is very much enjoyed both by passengers and crew.

[Figure 4 near here: helmsman with *guide* (steering-rod)]

Also hydrodynamics matter. True, the rotation speed of a four-stroke mono-cylinder is much lower than the one of a classical outboard engine, but the diameter of

[21] At the moment of writing, a new system is being experimented with that improves the helmsman's visibility. A steering wheel is placed in the baleinière's bridge, which is mechanically connected by way of iron cables to the rudders at the stern.

its helix being larger, and its torque therefore superior, the shotteur turns out to be the more suitable solution to propel a weighty vessel. On heavier boats, the concentrated jet a classical outboard engine generates simply deflagrates, where a water jet caused through a larger blade length of the screw is more advantageous. This more adapted, and therefore more efficient, use of internal combustion energy explains the low fuel cost of the dakadaka, if compared to the former outboard solution.[22] The owner of the HB Matthieu 7:7 remembers: 'Before, to get from Lileko market to Kisangani and back (ca. 280 km in total), with two Yamaha outboard engines, we consumed about 700 litres of gasoline. Now, with two changfa 30hp engines, it takes us not more than 250 litres upstream, and 100 litres to get back. This has allowed us to reduce the price for the customers.'[23] The encouraging impact this has on the trading population cannot be overestimated, particularly in an economic context of precarity where every additional cent is used as investment capital to increase a journey's profitability.

> The commander signals to his deputy Michel (but Alino I has already seen it), that a screw is lose between M1 and its chassis. I had also seen it, but felt I should not intervene. The third mechanic, Nono, is bringing (sniff) tobacco for the commander. I am offered some, but I roll my hand with a pointed index to make the sign for 'later'. The *bidons*, full now, are lifted up from the lower deck. For the second time, Nono, who is older than the two Alinos, orders a bunch of young boys to move out of the way. They are eating their *kwanga* with *madesu* (beans) right in the middle of the pathway where Alino is running to and fro with gasoline containers.

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[22] At the moment of writing, the combination of engines, shotteurs, and helixes of different sizes is being experimented with. If initially a 'moteur ya 30 [chevaux]' would be coupled with a 'shotteur ya 30' and a 'hélice ya 24' or 'ya 30', the most recent baleinières (in September 2019) were experimenting with the combination of a 30hp engine with a 60hp shotteur driving a 30hp helix. The choice of a larger shotteur, mechanics explain, reduces the stress on the gearboxes and thus increases their lifespan. The resulting insights are gathered and redistributed by the local shotteur trader.

[23] Interview, baleinière owner Jean-Frédérique Litofe, Isangi 22.09.2017.

> M4 is running again, but smoking heavily. Alino II is filling up its tank. The engine block of M1 is still not fixed, and the commander is now all nervous about it. I touch Nono at his shoulder and point to the problem. Where is Alino, who had seen it before? Some other more urgent matter must have distracted him. One of those crew members, who had been helping with the pouring of gasoline down below, has a crocodile tattooed on his forearm. M3's tank is loose and has started shifting. It's one of the spectating passengers who draws Alino I's attention to it. Collective engine therapy management?![24]

John Janzen's concept of 'therapy management' (1987) indicates the emphasis family members of an afflicted person in Lower Congo place on the joint responsibility to resolve the spiritual origins of an illness. This is indeed at least suggestive, as all engines are systematically taken care of and repaired collectively. While the three mechanics are the exclusive executives of any actual intervention, the concern for the engines' well-being is shared by various participating actors, regardless of rank and status. Indeed, the perpetual maintenance resembles a situation of collective 'care' rather than 'repair' work. It is done jointly by mechanics, crew members, and even passengers, who collectively interact as if in a therapeutic community. The community of practice at work on baleinières is decidedly horizontal, not hierarchical, which also signals an overcoming of (post-)colonial status mimicry.

The distributed form of mechanical labour, or engine care, is enabled by the spatial setup of the engines. Larger marine diesel engines are often more compact, with pistons moving vertically, and their engine bloc uniting six to eight cylinders in a space not larger than one cubic meter. Installing two to seven separate, horizontally moving 24 or 30 hp Chinese mono-cylinder blocs next to each other, on the other hand, is like dismembering such a larger engine bloc and spreading it across the engine room. Here,

[24] Engine ethnography of 9 November 2017.

each cylinder has its separate place at the stern of the boat, and each one powers its own respective shotteur and screw.[25]

This fragmented, or spatially distributed configuration of cylinders affords each motor to be serviced and repaired separately, while all the other cylinders/engines continue running. It is indeed rare to find a baleinière on which there is not at least one dakadaka that 'got tired' and is being repaired during the journey. Each piston can be serviced without the other ones having to stop.

As a result, a baleinière quasi never suffers breakdowns that force it to stop, which makes its movements predictable and relatively reliable. In a context without organized logistics and courier services, this is a striking advantage for local trade and traders. Few are those who, before the advent of the dakadaka, have not already had to wait for days, along with their tradables, in case a spare part had to be bought to fix an engine failure.

Removing the backward gear

The Chinese shotteur is equipped with two gearboxes that transmit the engine's force across two angles of ninety degrees down to the propeller. The upper gearbox originally contains two vertical tooth wheels: a forward gear and a backward gear. In between these two is the 'neutral' position, in which the traction of the engine is disengaged. The gears are by far the most fragile parts of the propulsion system, which require replacement more often than others. It is the helmsman who senses an upcoming

[25] In comparison with a marine Diesel engine, the differences are striking: only specialized technicians from the Chanic Metal company in Kinshasa is able to align the *arbre* (shaft) that connects the engine to the screw. Inadvertently, baleinières recuperate the advantage of steamboats: their entire propulsion system can be serviced and repaired without the boat having to get out of the water.

gearbox problem through grainy vibrations in the steering rod. If this happens early enough, the used up gear can still be repaired by means of welding with Castolin. In order to reduce unnecessary friction inside the gearbox, before its first use, the backward gear is removed from the gearbox and transformed into a spare forward gear. The forward gear and the clutch are then welded together, to prevent dislodging. The missing backward gear is compensated for by the natural thrust of the River, which provides for a relentless directional force sufficient for pushback when leaving the shore. In the case of manoeuvring in more shallow waters, especially when being loaded at one of the local periodic markets, a baleinière can easily get stuck in the mud of the riverbed. In such a case, the River's thrust is supported by the combined muscular force of a dozen of dockers, who push the baleinière into deeper waters.[26] Once again, muscular and natural forces join in with the engineered forces of the engine, this time substituting the missing backward gear so as to prolong the lifespan of the shotteur.

Next to the River's intrinsic thrust, its water is also put to use. In their most elementary form, stationary engines like the dakadaka have a cylinder block surrounded by water, which is meant to evaporate at the top end of the hopper. Aboard of baleinières, given the handy presence of river water as an omnipresent coolant, local mechanics have started equipping it with a water pump. Thus, by opening the outlet valve, the evaporative cooling system is transformed into a proper single-cycle water-cooling system, with the River literally running through the hopper. This, mechanics explain, allows to reduce the engine's running temperature and prevents it from

[26] In this case, Simone's concept of 'people as infrastructure' (2004) applies quite literally.

overheating. To economize on water pumps, one pump serves two neighbouring engines, whose cooling circuits are connected with the help of a hose.[27]

> A yellow *bidon* is now being transformed into a hanging tank. A hole is pierced, first with a nail, then with a screw, so Alino I can force a piece of plastic hose into it. Not bad, I am thinking, to know how to precisely manipulate a plastic jerrycan so as to tuck a rubber hose into it in such a way that nothing is leaking afterwards.
> One passenger, about sixteen years old, is watching from close by, munching on a piece of sugar cane. The commander is gesticulating to him (I didn't get it at first), that the driver's seat on which he is sitting on the starboard of the baleinière, needs to be cleared. Rapidly, he moves away. Alino II holds the steering rod now, for the helmsman to move over to the other side.
> Alino II drives a nail into the wooden pillar for the new petrol tank to be attached. It looks like a baxter that's soon going to lend its engine patient a fresh infusion of diesel. Not only are these new tanks bigger than the original ones, their position above the mechanics' heads allow them to constantly screen the fuel level against the light. Now, M3's original tank is short-circuited. Something is running out of it. They must have forgotten to empty it before removing the hose from the bottom valve. A young man with a cigarette appears and seems to want to go down where the fuel transpouring just happened. Everything is full of diesel down there. I gesticulate that this might perhaps not be a very good idea. He anyways climbs down the stairway. Even if it's not gasoline, can it not burn, still? It's a wooden boat, after all. He will probably think the stains are just water at the bottom of the hull. I appease myself by remembering that gasoline does not explode.
> M3, and also all other engines, are now slowed down, so the mechanics can join their efforts to remove M3's tank. Alain now fully unscrews the valve at its bottom and treats it roughly with a hammer, preparing it for the accommodation of the hose hanging down from the baxter-like jerrycan. Some minutes later, all engines are put back to speed, running, I think, at full throttle, and fed now, entirely, with fuel out of yellow *bidons*. M3's tank was actually not broken, it was only loose, but they removed it anyways. And: each semi-transparent tank can now be refilled from the upper deck, without having to interfere in the workspace of the mechanics. The engine is spread out, really.

[27] Other work sites where dakadaka engines are used as stationary engines with incessant 12 hour shifts, such as rice threshers, welding workshops or when used with an electric generator, also use a pump and a hose to connect the engine's hopper and exhaust valve to a barrel filled with water. The latter is usually placed outside the building and, by serving as an external condenser, evacuates the engine's heat.

> It's an ongoing procession here. A woman is taking a big cup of small tomatoes out of one of those huge baskets downstairs and hands it to a boy in an apron, who is the crew's private chef.
> Nono is now tightening the screw of M2. He is also barefoot, just like Alino II. All mechanics are barefeet. 16.57h. We are passing the old abandoned sugar cane plant of Lotokila, a Sino-Zairian agro-industrial plant of Mobutu's times. All three mechanics, Alino 1, Alino 2 and Nono, are eating fish from the same plate. One passenger has brought his personal life vest. He is the only one wearing one. If I see it correctly, also M3's exhaust pipe is loose. Just like the ones of M2 and M1: none of the brand-new engines has maintained its original exhaust pipe.
> Commandant Michel has now taken over the steering rod. The screw that fixes the shotteur to its chassis is also loose. After one journey, all three exhaust pipes are broken and removed. Without a proper, separate water cooling, they literally melt if the engines are driven at full throttle for so long.[28]

Technical adaptation, i.e. the 'opening up' of a technology has been industrially produced as a 'closed system' elsewhere, either happens through instances of what is often locally called 'topicalization' (Verrips and Meyer 2001; Park 2017) or 'modding' (Beck 2009), which usually happens before it is put to use in a novel setting. Adaptations also occur more gradually during the usage phase, when they are introduced in acts of 'retrofitting' (Howe et al. 2016, Johnson et al. 2021) or 'adjustment' (Tastevin 2011). This is often a result of insights during maintenance, or after breakdowns and subsequent 'mending' or 'repairing'. Being born out of local interests or necessity, adaptations are mostly informed by knowledge based on skill, experience and creativity, which in turn feeds on 'tinkering' (Mol et al. 2010), and improvisation (Ingold 2000). Given that over time a successful act of tinkering can be repeated and prove itself to be an apt solution, thus undergoing a process of 'routinization', it can end up becoming the standard measure of topicalization, which obviously blurs the conceptual distinctions suggested here.

[28] Engine ethnography of 9 November 2017.

The ethnography of the dakadaka and its shotteur stern drive provides ample evidence of such adaptive measures, which, taken together, enable the engines to unfold their socio-technical potential: interventions such as the prolongation and coupling of the steering rods (see above), the removal of the backward gear and the addition of water pumps for cooling, are undertaken *before* the engine's or the shotteur's inaugural journey. Other adjustments ensue during the first journey, such as the removal of the exhaust pipes, the addition of a cardboard gasket to the gear box lid, and the replacement of the original fuel tanks by mobile yellow jerrycans (Fr.: *bidon*). The latter can be removed, carried, refilled and repositioned from without actually entering the engine room. While this contributes to the social and spatial distribution of the engine, on the one hand, the translucent quality of the yellow plastic allows for a constant surveillance of the fuel level, on the other.

Cooling down

Despite frequent accidents mostly due to navigation errors, poor or excessive loading, or moving underwater obstacles, the association of Congo's artisanal baleinières and their Chinese propulsion technology is a success story. While the ethnographic account has anything but concealed the material fragility of the dakadaka engine, it has shown the extent to which the engines are technically adapted to, or 'baptised into' (Verrips and Meyer 2001) the natural, human and socio-spatial specificities of their new artisanal habitat. Their resilience and efficiency are not so much the outcome of intrinsic material and technical duress, or solely of the successful outsourcing of labour from man to machine. Rather, it is the fruitful integration and entanglement of technology, people and their natural surrounding that make Chinese engines successful appropriate technologies on Congo's inland waterways.

Contrasting with the deterministic bias of 'technology transfer' as a linear diffusion of socially, materially and technically stable, or 'closed', technological artefacts, it has become commonplace among social scientists that technologies, as things, have social lives (Appadurai 1986) and biographical trajectories (Kopytoff 1986), during which they undergo technical adaptations, social and symbolic appropriations, and a complex overall socio-technical re-entanglement within their new respective habitat. When technologies travel, they are thus materially 'opened up' again, socially re-entangled and also symbolically re-inscribed. This blurs the boundaries between production and consumption (Beck 2009), and reveals the social construction of their existence (Bijker, Hughes and Pinch 1987) rather than merely the impact they have on a putatively independent context.[29] De Laet and Mol (2000) have influentially argued that the success of a technology such as the Zimbabwe bush pump depends on its 'fluidity', i.e. its ability to integrate a volatile ensemble of actants that is variable and dynamic in scope and pragmatic efficacy. While the technical adaptations discussed in this article undoubtedly also increase the engines' ability to 'flow in' with their new riverine habitat, our ethnographic focus on their actual use has revealed how they also integrate forces (water, muscles, engine power) and social competencies at work *during* their operation.

Against the background of baleinières' impressive floatablity (mainly due to the use of a *tola* wood), the economic, hydrodynamic and socio-technical affordances dakadaka engines unfold during their service – and which are brought to full force by a range of technical modifications – have enabled baleinières to increase in size, to multiply in numbers, to improve their safety (unlike fuel, Diesel does not explode), and to widen their reach and their carrying capacity. Along with the popularity of Chinese and Indian motorbikes, the changes induced by baleinières and their dakadaka engines thus indicate a democratization of Congo's transportation sector, both in terms of access to mobility, and of the chances for accumulation and entrepreneurship this entails.

[29] Bijker, Hughes and Pinch (1987: 163) emphasize the 'interpretive flexibility' technologies bear, while Akrich (1997) stresses the instability of the underlying operational script they can be "de-scribed of" when travelling.

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References

Akrich, Madeleine. 1997. "The De-Scription of Technical Objects." In *Shaping Technology/Building Society: Studies in Sociotechnical Change*, edited by Wiebe Bijker and John Law, 205-224. Cambridge: MIT Press.

Appadurai, Arjun. 1986. *The social life of things: Commodities in cultural perspective*. Cambridge: Cambridge University Press.

Bansah, K.J., A.B. Yalley, and N. Dumakor-Dupey. 2016. "The hazardous nature of small-scale underground mining in Ghana." *Journal of Sustainable Mining* 15(1): 8–25.

Beck, Kurt. 2001. "Die Aneignung der Maschine." In *New Heimat*, edited by Karl-Heinz Kohl and Nicolaus Schafhausen, 66–77. New York: Lukas & Sternberg.

Beck, Kurt. 2009. "The Art of Truck Modding On The Nile (Sudan): An Attempt To Trace Creativity." In *The Speed of Change. Motor Vehicles and People in Africa, 1890-2000*, edited by Jan-Bart Gewald, Sabine Luning and Klaas Van Walraven, 151–174. Leiden: Brill.

Beck. Kurt. 2012. "Crisis, Innovation, and the Social Domestication of the New: one century of Manâsîr social history." In *Nihna nâs al-bahar - we are the people of the river: ethnographic research in the fourth Nile Cataract Region, Sudan*, edited by Cornelia Kleinitz and Claudia Näser, 5–48. Wiesbaden : Harrassowitz.

Beisel, Uli and Tillman Schneider. 2012. "From 7/83-2 to Dr. JESUS: The transformation of a German ambulance car to a Ghanaian bus." *Environment and Planning D: Society and Space* 30 (4): 639–654.

Biggs, Stephen, Scott Justice and Davis Lewis. 2011. "Patterns of Rural Mechanisation, Energy and Employment in South Asia: Reopening the Debate." *Economic and Political Weekly* 46 (9): 78–82.

Bijker, Wiebe E., Thomas Parke Hughes, und Trevor Pinch (eds.). 1987. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, Mass: MIT Press.

Botchwey, Gabriel, Gordon Crawford, Nicholas Loubere and Jixia Lu. 2019. "South-South Irregular Migration: The Impacts of China's Informal Gold Rush in Ghana." *International Migration* 57 (4): 310–328.

Cabada Rodriguez, Pablo D. 2017. "We Move with Water and Gold: The Scales of Urban Mining in the South-West of Ghana. Interlacing (In)Formal Small Scale Mining and Global Environmental Concerns in Tarkwa." M.A. Thesis, Leiden: Leiden University.

De Laet, Marianne and Annemarie Mol. 2000. "The Zimbabwe Bush Pump: Mechanics of a Fluid Technology". *Social Studies of Science* 30 (2): 225–63.

Edgerton, David. 2006. *The Shock of the Old: Technology and Global History since 1900*. London: Profile Books.

Faraj, Samer and Azad Bijan. 2012. "The Materiality of Technology: An Affordance Perspective." *Materiality and Organizing: Social Interaction in a Technological World*, edited by Paul M. Leonardi, Bonnie A. Nardi, and Jannis Kallinikos, 237–258. Oxford: Oxford University Press.

Gewald, Jan-Bart. 2015. "Energy: Internal Combustion Engine." In *New Encyclopedia of Africa*, edited by John Middleton and Joseph C. Miller. Vol. 2, 271–274. Detroit et al.: Thomson-Gale.

Hänsch, Valerie. 2009. *Sifinja – The Iron Bride*, 70 Min., DVD (www.sifinja.de)

Harms, Robert W. 1981. *River of Wealth, River of Sorrow: The Central Zaire Basin in the Era of the Slave and Ivory Trade, 1500-1891*. New Haven: Yale University Press.

Howe, Cymene et al. 2016. "Paradoxical Infrastructures: Ruins, Retrofit, and Risk." *Science, Technology and Human Values* 41(3): 547-565.

Huybrechts, André. 1970. *Transports et structures de développement au Congo: étude du progrès économique de 1900 à 1970*. Paris: Mouton.

Ingold, Tim. 2000. *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*. Abington and New York: Routledge.

Gibson, James J. 1966. *The Senses Considered as Perceptual Systems*. London: Allen and Unwin.

Jacobs, P.A. 1956. “La dieselisation du matériel de transport au Congo belge.” *Comptes rendus des journées d’études des transports au Congo belge*, 4-5 october 1956, Brussels: Ministère des Colonies.

Jafari, Soheil et al. 2017. “A review of evaporative cooling system concepts for engine thermal management in motor vehicles.” *Journal of Automobile Engineering* 231 (8): 1126–1143.

Janzen, John M. 1987. “Therapy Management: Concept, Reality, Process”. *Medical Anthropology Quarterly* 1 (1): 68–84.

Johnson, Charlotte, Sarah Bell, Aiduan Borrion, and Rob Comber. 2021. “Working with Infrastructural Communities: A Material Participation Approach to Urban Retrofit.” *Science, Technology, & Human Values* 46 (2): 320–45.

Joulian, Frédéric, Yann-Philippe Tastevin, and Jamie Furniss. 2016. “Réparer le monde : excès, reste et innovation." *Techniques & Culture. Revue semestrielle d’anthropologie des techniques* (65–66): 14–27.

Kopytoff, Igor. 1986. “The Cultural Biography of Things: Commoditization as Process”. In *The Social Life of Things: Commodities in Cultural Perspective*, edited by Arjun Appadurai, 64–92. Cambridge: Cambridge University Press.

Lambertz, Peter and Victor Yaaya Liagologa. Forthcoming. “Les « transportants » de Kisangani : bus, baleinières et leurs entrepreneurs/armateurs entre renouveau et continuité”, paper presented at the conference ‘Central African Renaissance’, organized by the Central African Studies Association (CASA), Kinshasa, June 2021.

Lambertz, Peter. Forthcoming a. “Congo’s Whaleboat Builders. Making Artisanal Transportation on Congo’s Inland Waterways”, article in preparation.

Lambertz, Peter. Forthcoming b. “Untamed Infrastructures. Inequality, Risk and Promise on Congo’s Inland Waterways”, in: *Religion* (special issue “Religious Infrastructures”, eds. Yanti Hölzchen and Benjamin Kirby)

Larkin, Brian. 2016. "Ambient Infrastructures. Generator Life in Nigeria." *Technosphere Magazine*, available at /p/Ambient-Infrastructures-Generator-Life-in-Nigeria-fCgtKng7vpt7otmky9vnFw. Last accessed February 26, 2021.

Lederer, André. 1965. *Histoire de la navigation au Congo*. Tervuren: Musée Royal de l'Afrique Centrale (Annales Sciences historiques, 2).

MacGaffey, Janet. 1987. *Entrepreneurs and Parasites: The Struggle for Indigenous Capitalism in Zaire*. Cambridge: Cambridge University Press.

Mol, Annemarie, Jeanette Pols, Ingunn Moser. 2010. *Care in Practice: On Tinkering in Clinics, Homes and Farms*. Bielefeld: Transcript Verlag.

Naipaul, Vidiadhar Surajprasad. 1980. *A Bend in the River*. Middlesex et al.: Penguin Books.

Northrup, David. 1988. *Beyond the Bend in the River: African Labor in Eastern Zaire, 1865-1940*. Athens, Ohio: Ohio University Press.

Park, Emma. 2017. *Infrastructural Attachments: Technologies, Mobility, and the Tensions of Home in Colonial and Postcolonial Kenya*. PhD diss., University of Michigan.

Pourtier, Roland. 1993. "La désorganisation des transports et la spirale du sous-développement au Congo." In *Dynamique des systèmes agraires: politiques agricoles et initiatives locales: adversaires ou partenaires* : edited by C. Blanc-Pamard, 49–69. Paris: Ostrom.

Raeymaekers, Timothy. 2014. *Violent Capitalism and Hybird Identity in the Easten Congo: Power to the Margins*. Cambridge: Cambridge University Press.

Takamura, Shingo. 2015. "Reorganizing the distribution system in a post-conflict society: a study in Province Orientale in the Democratic Republic of Congo." *African Study Monographs Suppl.* 51: 77–91.

Tastevin, Yann-Philippe. 2011. "Panne de transmission : une chronique mécanique de la diffusion de l'autorickshaw." In *Profils d''objets : Approches d'anthropologues et d'archéologues*, edited by F. Wateau, C. Perlès and P. Soulier, 231-242. Paris: De Boccard.

Tastevin, Yann-Philippe. 2012. *Autorickshaw : émergence et recompositions d'une filière entre l'Inde, l'Égypte et le Congo.* PhD thesis, Universiy of Paris Ouest Nanterre La Défense.

Tollens, Eric. 2003. "L'état actuel de la sécurtité alimentaire en R.D. Congo: diagnostic et perspectives." *Katholieke Universiteit Leuven: Département d'Economie Agricole et de l'Environnement: Working Paper* 77, Leuven: KU Leuven.

Verne, Markus, Paola Ivanov, Magnus Treiber, and Kurt Beck (eds.). 2017. *Körper, Technik, Wissen: Kreativität und Aneignungsprozesse in Afrika: in den Spuren Kurt Becks*. Berlin: LIT (Beiträge zur Afrikaforschung, 79).

Verrips, Jojada, and Birgit Meyer. 2001. "Kwaku's Car: The Struggles and Stories of a Ghanaian Long-Distance Taxi-Driver." In *Car Cultures*, edited by Daniel Miller, 153–84. Oxford: Berg Publishers.

Yuan, J. (2005), "The Status of China's Agricultural Machinery Industry and the Prospects for International Cooperation." *Agricultural Engineering International: the CIGR Journal of Scientific Research and Development* 8.

Figures

Figure 1

Figure 2

Figure 3