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Paper or pixel? Don't burn those books just yet

By Monica Guzmán, Seattle Times

Editor's note: Monica Guzmán's column appears in Sunday's Seattle Times. The column below appeared in the March 23, 2014 issue. It is reprinted here with permission.

At a Starbucks near my house this month, I saw a man reading a newspaper, a woman reading a book and another woman, near them, reading a magazine.

I peered at them over my laptop, at which I'd blinked and stared for at least an hour, and felt something crazy.

I felt jealous.

Paper is the has-been of the communications revolution. It weighs a bunch. It doesn't update. And if you want to compose a message, you can't hit "send."

And yet: In 2014, if you're reading something on paper for a while in a coffee shop, I know something about you in that moment. I know that you are free.

And a part of me wants to walk up to you, shake you by the collar (OK, maybe not) and ask how in the world you manage it.

If you've done nothing but read books and newspapers in coffee shops since before there was Wi-Fi, you're probably shaking your head. Are these gadget people completely insane?

Maybe. But the contrast is interesting: A few years ago I would've spotted those paper mongers — my laptop and iPhone a temple to new-age productivity — and felt oh so superior.

Is that a print edition of The New York Times? The one that got old the second it rolled off the presses and doesn't have this great photo slideshow? That's nice. And is that a hardcover book that weighs and costs twice as much as the same book on my Kindle?

I used to think people reading paper were behind the times. Now I think they're blissfully free from them.

By "free," you might think I mean free of work — as in, I've got pressing stuff to do and they don't. That's not what I mean at all, though work is of course a part of this. It helps to think about what paper is — and isn't — to see why.

When we compare paper with digital, we compare them as media — stuff on which other stuff is written. One is smart, the other dumb. Point: digital.

But compare paper and digital as *devices* — things made for a purpose — and it's a different story, one we rarely tell.

Paper's purpose is simple. You look at it or you put something on it. That's it.

Most of the devices on which we read digital media, on the other hand, have purposes as infinite as the operations they perform. You could be updating a project spreadsheet on your laptop, but then here comes a chat message or a new blog post. You could be scanning your Facebook app on your smartphone, but there's that calendar alert and isn't it time you check your email again?

Even when you're immersed in a news article on a digital device, different activities tempt you on all sides. Here's an ad you can click. Ten other articles you can read. Some flashing nonsense about belly fat. And always there, in the back of your mind, the other things you can check before you put this thing back in its pocket. It'll just take a minute. Or five. Or 10.

Next to the capabilities of digital, paper is dumb. But next to the tranquility of paper, digital is an assault. Alive with possibilities but full of demands. Always connected but never done. Triggers, enablers, provocateurs.

See a book in a corner and you think of the book. See an iPad in the corner and you think of everything you could be doing with it, at all hours of the day, because

that's the world these devices have created with our complicity — a world that never rests. A world that forgot how.

A world where paper is sweet, sweet sanctuary.

I said work was a part of this. Really, it's our lust for productivity. That lust puts a premium on doing it all, and doing it now. That's what has given rise not only to portable devices, but portable devices that do everything.

There's an app for that, and this, and that. As we pile them on, we pile on the expectations. The device grows heavier and heavier, clings tighter and tighter, and nothing seems possible without it.

But if you're reading on paper, maybe you know that's just not true.

I love digital devices. They're my superpower. But somewhere in this mechanical bounty, I think we mistook simple for "dumb," just because it came before something we've come to call "smart."

Not long ago I was convinced paper was outdone. Outperformed. Beaten. It wasn't a question of whether paper would die, but when.

Now, I hope it sticks around long enough for us to know why we would want it to.

Is Commercialization of Nanocellulose on the Horizon?

Tear a sheet of paper and look closely at one of the jagged edges the tear has created. Those tiny hair-like bits sticking out of the edge are pulp fibers. (At an earlier stage of their lives they were tracheids -- wood cells -- but that's another story; see the "Technology for the Nontechnical" article below.) If, for example, the paper was made from spruce wood, one of those fibers weighs about one three-millionth of a gram. A billion of them would together weigh slightly more than two-thirds of a pound. One might typically be about one tenth of an inch long and one thousandth of an inch wide or, in metric system terms, about 3 millimeters long and 3 hundredths of a millimeter wide. Clearly, a single pulp fiber is a tiny thing, at least in terms of our normal, everyday way of viewing things.

But let's take a closer look. Each fiber consists mainly of cellulose molecules. In microscopic terms, a cellulose molecule is a very long chain, consisting of thousands of links. Each link is a ring made up of carbon, hydrogen and oxygen atoms. The fiber,

although small, is an assemblage of many thousands of cellulose chains.

Within the fiber, the cellulose chains occur in both ordered and disordered regions. In the ordered regions, they are parallel to one another and connected by interatomic forces. These are crystalline regions. Chaotic, or "amorphous" regions separate crystalline regions from one another. In nanocellulose production, the fibers are treated to separate the crystalline regions from the amorphous ones. This results in the formation of extremely small crystalline fragments. So small, in fact, that their dimensions are expressed in billionths of a meter – nanometers. (One nanometer is equal to 0.0000000393 inches.) These fragments constitute nanocrystalline cellulose, sometimes called cellulose nanocrystals (CNC). They are one form of nanocellulose.

Pulp fibers are tiny, but nanocellulose particles are much, much tinier.

CNC is one of two forms of material that are referred to as nanocellulose. The other is cellulose nanofibrils (CNF), which consist of cellulose that exists as a nanodimensional mixture of both crystalline and amorphous cellulose. CNF is sometimes referred to as nanofibrillated cellulose (NFC).

So why all the fuss? Why does the paper industry see nanocellulose production as one of the technologies that will be a part of its transformative strategy? The answer lies in the unique sets of properties exhibited by nanocelluloses. As well as being renewable and nontoxic, they have high tensile strength, high stiffness, low permeability and low porosity. They impart very high strength to composite materials without significantly increasing their weight. According to a Wikipedia article, "[CNC's] tensile strength is about 500MPa, similar to that of aluminum. Its stiffness is about 140–220 GPa, comparable with that of [Kevlar](#) and better than that of glass fiber, both of which are used commercially to reinforce plastics. Films made from nanocellulose have high strength (over 200 MPa), [and] high stiffness (around 20 GPa). Its strength/weight ratio is 8 times that of stainless steel."

Potential applications are many, with new ones being continually developed. Nanocelluloses hold promise as strengthening agents for paper and paperboard, and their low permeability makes them suitable as barrier coatings. They can be used in composite applications, such as reinforcing plastics to give strong, lightweight components for automobiles and aircraft. Potential

uses in the food industry include use as low calorie thickeners, flavor carriers and suspension. They hold promise for use in in personal hygiene and absorbent products and are being investigated for use in emulsions, dispersions, oil drilling muds and hydraulic fracturing fluids for oil and gas recovery. There are possible medical, cosmetic and pharmaceutical uses and a host of other uses have been suggested (e.g., fibers films, cellulose derivatives, tobacco filter additives, battery separators, loudspeakers, flexible displays, computer components, lightweight body armor, etc.).

Nanocellulose's promise has not gone unnoticed by the paper and forest products industries. Several pilot plants are now in operation, their main purpose being to generate sufficient quantities of the nanomaterials to permit applications to be further explored and developed. The U.S. Department of Agriculture Forest Service has funded construction of a \$1.7 million facility at the Forest Products Research Laboratory in Madison, Wisconsin and another at the University of Maine. Other pilot plants have been built in Canada (Celluforce and Alberta Innovates), Finland (UPM-Kymmene and Stora Enso), Sweden (Innventia) and Japan (Nippon Industries). Capacities are in the 1 – 1000 kg/day range.

Given the promising characteristics of nanocellulose, the volume of precommercial research and development activity, and the forest products industry's quest for new business models, it appears likely that commercialization is not far off.

Trend Indicators from Industry Intelligence Inc.

[Industry Intelligence Inc.](http://www.industryintel.com) has provided market intelligence to more than 600 companies worldwide since it began as Forestweb in 1999. Industry Intelligence delivers a daily report featuring news of the paper and forest products industries. For your subscription visit: <http://www.industryintel.com>

Below is a small sampling of recent Industry Intelligence headlines, chosen to mirror significant trends in and around the paper and forest products industries.

Columbia Pulp submits conditional use permit for 140,000 tons/year straw pulp mill near Starbuck, Washington, application hearing set for May 9; company set to begin site preparation in fall, construction in early 2015

Plans are for the mill to use 700 tons/day of straw from area farms, employing about 130 people. The proposed mill's environmental impact has been deemed not to be significant after mitigation.

Paper industry will be revamped in years to 2030, with development of new products, shift to scope from scale, and focus on high profit margins, states new Innventia report; research will center on nanotechnology, followed by biorefining, niche products

An expert survey with 150 respondents from 21 different countries, together with other inputs, predicted biorefining to be the most profitable investment over the coming ten years. Nanotechnology will generate most attention in research, followed closely by biorefining and niche products.

World demand for corrugated boxes will rise 4%/year to 226 billion sq. meters in 2017, report finds, driven by improved economic outlook as developed markets in North America, Western Europe continue to recover from global economic downturn

Demand for manufactured goods will increase, stimulating sales of related packaging like corrugated boxes. The continued expansion of the electronic shopping market will drive heightened requirements for corrugated boxes used in the fulfillment of such sales. Advances will also be fueled by the expanded food, beverage and durable goods output, while rising construction spending will stimulate demand for goods and materials (and their related boxes) used in construction applications.

Demand for paper products in China forecast to keep growing during 2014-2018, but country's paper industry hampered by resource shortage, unreasonable product structure, low production level, serious environmental pollution: report

In 1999, total output of paper and paperboard in China was 29 million tons. In 2013, it was approximately 115 million tons. The CAGR during the years 1999 – 2010 was 11.9%. There are about 7,000 paper product manufacturers, with an average annual production per manufacturer of less than 20 thousand tons. At the end of 2013 only 6 manufacturers had annual outputs of over 2 million tons, and 10 others reached 1 million tons in 2012.

Revenue of cardboard box and container manufacturing industry in Canada expected to decline at annual rate of 3.4% from 2009 to 2014, reaching US\$4.3, report finds, with revenue forecast to continue to fall over five years to 2019

Sales to the manufacturing sector have declined, due to the long-term trend of offshoring manufacturing operations to low-cost countries that also provide access to emerging markets. Manufacturers continue to face escalating competition from imported corrugated products, particularly from the United States and China.

Fortum, UPM and Valmet launch five-year project to develop new technology to produce advanced lignocellulosic fuels to replace fossil transportation fuels; companies aiming to develop, commercialize catalytic pyrolysis technology for upgrading bio-oil

The project is a natural continuation of the consortium's earlier bio-oil project together with the VTT Technical Research Centre of Finland. The project is funded by Tekes – the Finnish Funding Agency for Technology and Innovation.

Resolute Forest Products temporarily restarts newsprint PM No. 5 at its Calhoun, Tennessee, mill to develop new paper products, meet orders while its Augusta, Georgia, mill is down for annual maintenance, company says; PM No. 5 had been indefinitely shut

Resolute stated when announcing the shutdown last March that the mill's two specialty paper machines and pulp dryer would continue to operate.

Klabir contracts Andritz to supply new 1.5 million tonnes/year pulp mill project in Ortigueira, Paraná, Brazil, which is expected to start up in Q1 2016; comparably structured orders typically valued at about €300M

The pulp mill will have an annual production capacity of 1.1 million tonnes short fiber, and 400,000 tonnes long fiber.

Global folding carton market expected to grow at CAGR of 4.96% over 2013-2018 period, driven by increase in demand for packaged food and beverages as a result of increase in population and disposable income for many consumers around world, report finds

Also, technologies such as barrier coatings, quick response codes, and holographic images are enabling vendors to develop improved folding cartons.

Global diaper market forecast to grow at CAGR of 4.4% during 2013-2018 period, according to new report

Factors contributing to this market growth are increased average disposable income and increased R&D investments by vendors, but declining birth rates in developed markets could pose a challenge.

UPM's SC paper mill in Madison, Maine, should be able to hook up to natural gas pipeline within three weeks; mill is at end of the line for Summit Natural Gas's 68-mile pipeline, which was delayed by weather, lawsuit

The area's three large paper mills -- Sappi, in Skowhegan; Huhtamaki, on the Waterville and Fairfield municipal line; and Madison Paper Industries -- provided incentive for the company to expand the pipeline north of Augusta.

Newsprint market in China plagued by overcapacity due to overbuilding and drop in consumption by newspapers, which themselves are in decline; China's newsprint output expected to be flat in 2014, according to report

China's newsprint consumption fell by 330,000 tonnes year-over-year in 2013, to 3.07 million tonnes, while newsprint production in China totaled 3.7 million tonnes

Global printing industry in midst of transition from a product-driven industry to a service-driven one, finds drupa report; while digital printing plays increasing role in technology mix, conventional printing continue to be important pillar

Digital printing plays an increasing role but conventional printing continues to be important as 29% of all printers say they intend to invest in sheet-fed offset printing.

Washington, D.C. lobby group Consumers for Paper Options seeing progress in its campaign to retain paper usage by US federal agencies, which seek to lower costs by moving mailings to the Internet; group claims studies show most Americans want paper, too

Rep. Sean Duffy from Wisconsin and Rep. Michael Michaud from Maine have introduced a measure calling for government action to ensure people are given "paper-based" information along with electronic. An op-ed piece in December's Roll Call that was signed by Michaud and Duffy noted that the shift to paperless was "disenfranchising millions of seniors and other vulnerable Americans."

Georgia Institute of Technology researchers develop new low-temperature fuel cell that directly converts biomass to electricity using catalyst activated by solar or thermal energy; hybrid cell can use biomass feedstocks including starch, cellulose, lignin

"We have developed a new method that can handle the biomass at room temperature, and the type of biomass that can be used is not restricted – the process can handle nearly any type of biomass," said Yulin Deng,

a professor in **Georgia Tech's School of Chemical and Biomolecular Engineering** and the **Institute of Paper Science and Technology (IPST)**. "This is a very generic approach to utilizing many kinds of biomass and organic waste to produce electrical power without the need for purification of the starting materials." The new solar-induced direct biomass-to-electricity hybrid fuel cell was described February 7, 2014, in the journal *Nature Communications*.

IP again makes list of Fortune magazine's most admired companies globally for 2014, ranking No. 1 in Forest and Paper Products industry for eleventh time in past 12 years

Companies are scored in nine categories: ability to attract and retain talented people, quality of management, social responsibility to the community and the environment, innovativeness, quality of products or services, wise use of corporate assets, financial soundness, long-term investment value and effectiveness in doing business globally.

UPM to invest €160M in Kymi NBSK, BHKP pulp mill in Kouvola, Finland, increasing capacity 170,000 tonnes/year to 700,000 tonnes/year, marking significant part of UPM's target to grow its 3.3 million tonnes/year capacity 10% over next three years

"... the investment will advance the decoupling of UPM's pulp and paper businesses, which supports a clear management focus ..." says UPM CEO Jussi Pesonen.

Cool Planet Energy Systems breaks ground on first of three commercial-scale biorefineries company plans for Louisiana; US\$56M Port of Alexandria facility to go online early 2015 will use yellow pine woodwaste, forest byproducts to make gasoline

It will be capable of producing 10 million gallons of high-octane gasoline for blending at Louisiana refineries and is also marketing biochar, a co-product of the refining process that can be used as an agricultural soil supplement. By building micro-refineries with a capacity roughly 100 times smaller than a large oil refinery, Cool Planet can locate near concentrated biomass sources, reducing transportation costs and increasing efficiency. According to the Louisiana Economic Development Corp. this will enable the company to produce gasoline with a price that is competitive with oil refineries.

Port Townsend Paper's biomass cogeneration plant expansion, on hold for more than a year, could

proceed after Washington State Supreme Court upholds permit, denying appeal by environmentalists

The state Supreme Court supported the Washington State Dept. of Ecology and the Pollutions Control Hearings Board in deciding that the plant's emissions "would cause no significant environmental impacts" the Peninsula Daily News reported. The company's Environmental Director nevertheless noted that the project's future was uncertain. He said the company was watching the market, but that the falling price of natural gas had made this kind of renewable energy project "less attractive."

AF&PA Statistics

Since our last reporting of American Forest and Paper Association statistics releases, the Association has issued its January 2014 Printing and Writing, Kraft Paper, Containerboard and Paperboard Reports and its February 2014 Paperboard, Kraft Paper and Containerboard Reports.

Paperboard

February Total boxboard production decreased 1.3 percent when compared to February 2013 and decreased 8 percent from January. Unbleached kraft boxboard production in February decreased over the same month last year and decreased compared to January. Total solid bleached boxboard & liner production decreased compared to February 2013 and decreased compared to January. The production of recycled boxboard increased compared to February 2013 but decreased when compared to January.

January Total boxboard production increased 1.3 percent when compared to January 2013 and increased 1 percent from December. Unbleached kraft boxboard production decreased over the same month last year but increased compared to December. Total solid bleached boxboard and liner production increased compared to January 2013 but decreased compared to December. The production of recycled boxboard decreased compared to January 2013 and increased when compared to December.

Containerboard

February Production decreased 8 percent from January and was 2 percent higher compared to February 2013. The month-over-month average daily production increased 1.9 percent. Shipments for February were 2,692.1 tons, representing 151.7 billion square feet. The operating rate for February increased 1.8 points from January, from 94.6 percent to 96.4 percent.

January Production increased 3.8 percent over December 2013 and was nearly flat compared to the January 2013. The month-over-month average daily production also increased 3.8 percent. Shipments for January were 2,979.8 thousand tons, representing 167.8 billion square feet. The operating rate for January 2014 increased 3 points from December 2013, from 91.5 percent to 94.5 percent.

Kraft Paper

February Total shipments were 121.6 thousand tons, 5.1 percent lower than in January. Bleached kraft paper shipments were 3 percent lower than January, while unbleached shipments were down 5.3 percent. Overall, shipments for the first two months of 2014 were 4.5 percent lower than the same period last year. Total month-end inventories decreased 8.8 percent compared to January.

January Total shipments were 128.2 thousand tons, 2.2 percent higher than in December. Bleached kraft paper shipments were 51 percent lower than the same month last year, while unbleached shipments were down 2.7 percent year-over-year. Total month-end inventories increased 3.1 percent compared to December 2013.

Printing and Writing

Total shipments decreased 8 percent in January compared to January 2013, with decreases in all four printing-writing grades.

Uncoated free sheet shipments decreased 11 percent compared to January 2013, with inventories increasing 5 percent over December levels. Coated free sheet shipments decreased 4 percent compared to the same period in 2013 to 323,000 tons. Uncoated mechanical shipments decreased 2 percent in January, the first year-over-year decline in the past seven months. Coated mechanical shipments of 231,400 tons in January decreased 10 percent compared to January 2013.

The reports can be purchased by contacting Caroline Nealon at Statistics_Publications@afandpa.org or 202-463-2448.

Technology for the Nontechnical: Pulping

“No pulp, no paper!” is what the pulp mill people are fond of reminding the paper mill workers. The machines that turn out paper at rates measured in thousands of feet per minute and hundreds of tons per day are wholly dependent on a continuous supply of a dilute suspension of pulp fibers being fed to the machines. Most often, that pulp is made from wood and, although there are a variety of processes for turning wood into pulp, the one most often encountered is the kraft process.

The wood is first subdivided into chips that are typically about one inch long and less than a quarter inch thick. The chips are fed to a pressurized vessel called a digester where they are exposed to a solution of chemicals (sodium hydroxide and sodium hydrosulfide) that have the ability to dissolve the “glue” (lignin) that holds the fibers together. The solution is called white liquor. The digester is heated under pressure to a temperature of 300 - 350 degrees Fahrenheit and maintained at that temperature for an hour or more. The pressure is then released and the contents are rapidly discharged, causing the cooked chips to disintegrate into fibers.

The spent cooking liquor (“black liquor”) is separated from the pulp fibers and routed to a recovery system where the material dissolved from the wood is converted to energy and the pulping chemicals are regenerated. The pulp may be further processed by bleaching, depending on the requirements of the grade of paper to be produced.

Statistics Corner: Nanocellulose Research Publications

As shown in Figure 1 below, the number of research and technical publications on nanocellulose has skyrocketed in recent years. Figure 2 identifies the countries in which most of the publications originated. Many were from the U.S. and China. ■

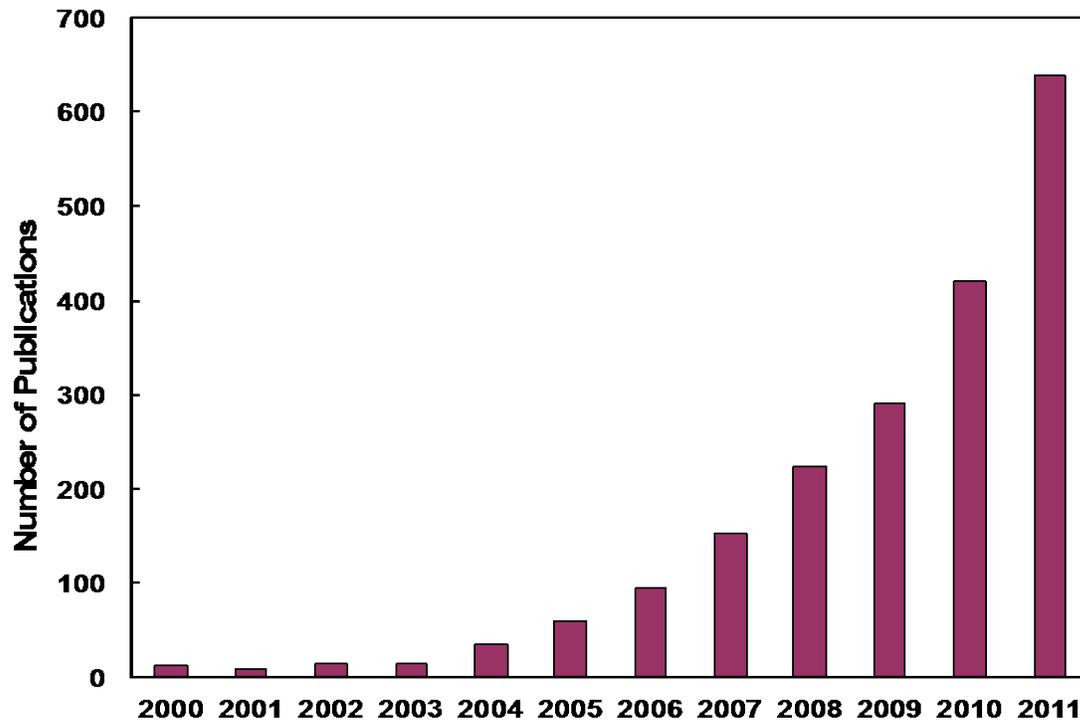


Figure 1. Research and technical publications on nanocellulose (Source: IPW Magazine)

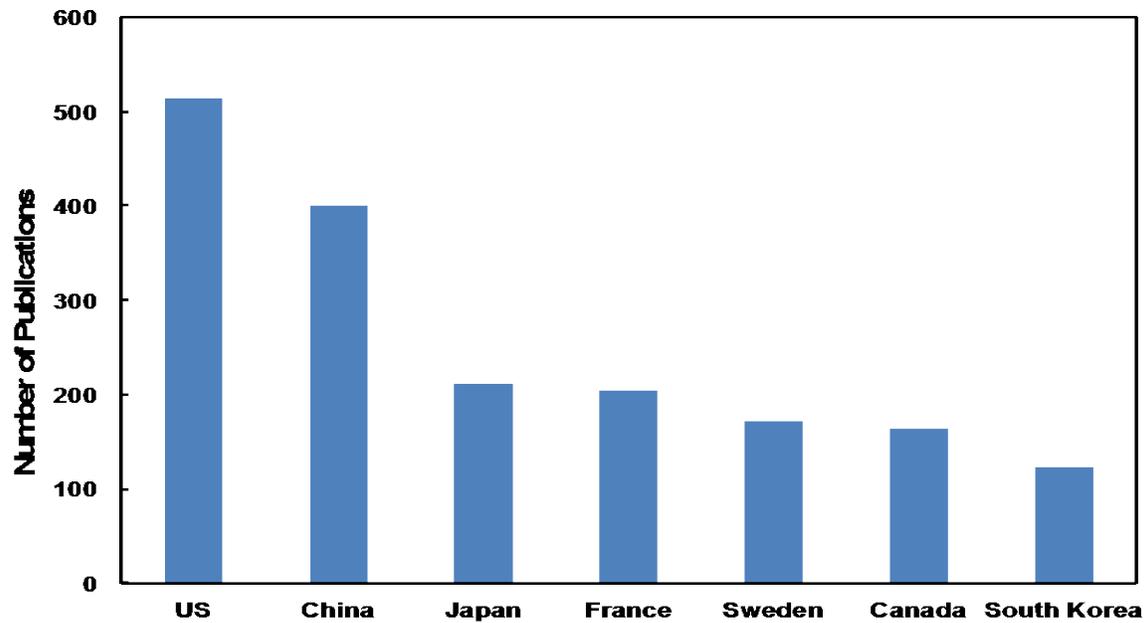


Figure 2. Top countries of origin of nanocellulose publications (Source: IPW Magazine)