HIGH ETICAL CONDUCT OF ENGINERS AS A VERITABLE TOOL FOR NATIONAL ECONOMIC ADVANCEMENT

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1.0 PROFESSIONAL ETHICS

Business Dictionary defines Professional ethics as:
Professionally accepted standards of personal and business behaviour, values and guiding principles. Codes of professional ethics are often established by professional organizations to help guide members in performing their job functions according to sound and consistent ethical principles (Web Finance Inc., 2020).
Tutorialspoint (2020) opine that: Ethics has its origin in the Greek word "ethos", which means "character". Thus ethics are a set of principles or rules generally considered as standards good or bad, right and wrong, usually imposed by a profession, society, regulatory body or even an external group.
Engineering ethics involves the decisions, policies and values that are morally desirable in engineering practice and research.
Aside moral issues, engineering ethics include but not limited to responsibility for safety, confidentiality, balanced outlook on law of the land/international law, global issues, professionalism etc. The word best practices often refer to the standard acceptable in a profession worldwide.
Juxtaposing the above with engineering itself being a process of developing efficient mechanism which eases and quickens the work in regards to limited resources and the help of technology.
Cutting edge technology therefore, permit me to say, enjoys the confidence of professional ethics.

1.1 CONFIDENTIALITY

It is very vital to note that an engineer or employee is expected to maintain the employer or organzations confidentiality. Though over the years one has observed that this employers confidence expected of the employee has been highly degraded. It used to be taken very seriously and employers entered it as a must condition before engaging an employee. His/her interview session must among other things include that. Even management staff in public and private sectors discuss their organizations' most guarded secrets without considering the grave import of what that meant.
Therefore, the practice which enables the keeping of secret in respect of all information seen as to be kept secret is called confidentiality.
By this, no data concerning an organization's technical processes and businesses that are not already in the public domain must be revealed. Companies treasure their secrets because that is the thing that makes them to remain competitive.

Note that it is on the platform of confidentiality that multi-national giants such as Coca-Cola and Guinness stout are still thriving on top of their competitors till date. The mixing formulae of the components of these two drinks – beverage and beer respectively remain highly guarded secrets.
Organizations therefore know the individuals and groups that are in possession of or have access to certain privileged information. Tutorialspoint (2020) notes that the responsibility of maintaining confidentiality thus lies on such groups or individuals.

1.1.1 ISSUES CONCERNING CONFIDENTIALITY

The major issue for confidentiality are as follows:

1. Intellectual property: this business concept involves creativity such as designs, symbols, names and images used in commerce, inventions, literary and artistic works, books, journals, music, etc.

To enable people earn recognition for their intelligence and genius, intellectual property (IP) is therefore protected by the law in the form of trademarks, copyrights and patents.
In our society today, people in an attempt to make quick money run foul of this IP law. By this, other people's ideas and inventions are utilized without due diligence of permission. The whole of Alaba International market is notorious for piracy.
Designs of infrastructural projects are freely copied and pasted without recourse to the law. A structural engineer

for example may replicate same designs already paid for by a client without recourse to taking permission. That is why one can hardly put up even an iconic project today without being copied.
It believes on an engineer working in any organization to avoid infringing on anyone's intellectual property. Some major organizations record their confidentiality expectation among other things in the form of guide books (do's and don'ts) for all employee's to maintain.
In Sept. 1998 – Sept. 1999, one was privileged to be one of the major engineers that executed the 50,000 capacity seat auditorium for Winners' Chapel which was till late 2018, the world's
largest auditorium by Guinness Book of Records. The day to day activities from Sept. 1998 – Sept. 1999 were recorded on video but was never released for circulation.

1.1.2 INFORMATION TYPES

Two types of information make up the confidential information. They are Proprietary Information and Privileged Information.

a. Proprietary Information – In this case the company involved is the proprietor of the information and owns it. It is a trade secret. Legally therefore, competitors are disallowed from manufacturing and selling the products unless with permission of the patent holder.

Note that for cases where there are no legal protection, reverse engineering could be employed for the product analysis so as to estimate its manufacturing for duplication or improving on that without any permission. Presently, I'm consulting for a Paving Stone and Concrete producing company at Owerri. The terms of reference is for me to give them a mix design which would lower their cost of production while having a higher compressive strength. Infact, they want to best other notable concrete and paving producing companies in Nigeria. With conventional materials of Portland cement, fine and coarse aggregates, AL – Consultancy Global Concepts Limited, found out there was no way to lower the production cost and to obtain comprehensive strengths higher than the 25 N/mm2 they had attained. However, with the introduction of Axion Engineering Products, tuffcrete in particular, paving stones crushed after just 3 days yielded 21 N/mm2 and in 7 days 30 N/mm2.
By Eurcode standard, compressive strength of 66 percent is obtained after 7 days curing. Therefore, in 28 days, a compressive strength of 45.5 N/mm2 would be arrived at.
Our mix design is such that with the tuffcrete, the quality of Portland cement reduced while coarse aggregates are totally eliminated.
In the final analysis, the company would reveal the compressive strength of their products to the public but never reveal their mix proportions. It's both proprietary and privileged information for the organization. However, the staff of the production team know this since I handed over the new mix design to them for adoption.

b. Privileged Information – this is available to one on a special privilege, especially on an employee working on a special assignment. Most management and very senior staff are employed on the basis of trust that they would not reveal privileged information at their disposal.

1.1.3 WHEN ONE CHANGES JOBS

The fact that one has left a particular working place does not end his/her obligation to protect confidential information. At least moral rules demand that they must neither reveal nor sell such information to the new employer. Though a job change may be necessitated by desire to earn more income or for a particular desired career growth, the trade secrets of the former company must not be revealed.
The engineers' knowledge base intuitively generates workable and unworkable designs with trade secrets being part of this knowledge base. Hence, the best time to release an employee is at the end of the project to avoid the huge temptation to reveal information.
Even employers encourage this revelation by asking the new employee; "how were you doing it in your former company?" They deliberately expect him/her to import secrets from former company to theirs under the cover of experience. This on its own is very unwholesome.

1.1.4 AUTONOMY OF INDIVIDUALS AND CORPORATIONS

Observing the rights and duties of autonomy along with its utilities involves:
1. Respecting the self-determination and freedom of individuals and corporations.
2. Recognizing that individuals and corporations have their legitimate control over some private information concerning themselves.
3. Once confidentiality is properly maintained, trust and trustworthiness can grow.

1.1.5 STRIKING A BALANCE BETWEEN EMPLOYEES AND MANAGEMENT ON CONFIDENTIALITY.

A win-win position between employees and management on confidentiality can be worked out.
While recognizing the rights of employers and protecting the rights of engineers and other employees, employment contracts with few imposed restrictions are resorted to. Such restrictions include – geographical location of future employers, the type of work one can do for future employers and the length of time to engage in certain kinds of work after leaving the

present employer. Most often though, courts tend not to recognize such contracts as binding for the fact that they threaten individuals rights to freely pursue their careers.
Alternatively, one or a combination of the following may be adopted

a. An agreement not to work on similar project for few years.
b. An agreement not to consult for another company on similar project till the project at hand is completely concluded. This makes for moral abiding by the consultants involved.
c. Knowledge base of engineers involved in research and development could be lessened allowing them in on trade secrets when and when they are imperative.
d. Generating and inculcating a life time professional responsibility that transcends the directives of current employers.

1.1.6 CONFLICTS OF INTEREST

This occurs when employees have entrenched interest that prevents the meeting of obligations with employers or clients when pursued.
Tutorialspoint (2020) opines that the meeting point of the understated conditions give rise to conflicts of interest:

i. The engineer is in a role that equips him to exercise good judgment to protect the interest of a client or an employer.
ii. The engineer beside his present job, has some other interests that could make him not exercise good judgment in protecting the client or employers' interest.

It must however be noted that an engineer working in an organization but having some side business makes him a potential competitor within or colluding with a competitor. Either way, it is a threat to the business survival of his employers. As soon as this is detected, it is better to fire such an employee or release him to pursue his outside interest.

1.1.7 SOME CONDITIONS THAT CREATE CONFLICTS INTERESTS

1. Gifts, Bribes and Kickbacks

In the day to day running of a business some small gratuities can be offered an engineer as gifts.
Kickbacks are prearranged by contractors to organizations or their representatives with the sole purpose of settling for contracts granted or to be granted.

Bribes are substantial in cash or kind usually offered with the aim of gaining unfair or unethical advantage.
Example – a dealer and supplier once supplied several tons of reinforcement on a project I was managing and executing few years ago for a client at Elele. A simple test proved they were cast iron – very different to bend but also very brittle. That was an easy trap for collapse. When I complained, the supplier kept calling and chasing with the aim of 'settling' me so that I keep quiet about it. Trust that I would not fall for such a cheap trap. He was therefore instructed to remove all the supplied reinforcements at short notice.
Substantial amounts offered as gifts actually threaten fairness on projects and turn out to be bribes or 'Greeks gift'. Therefore, the rule of thumb according to Tutorialspoint (2020) is: "If the offer or acceptance of a particular gift could have embarrassing consequences for your company if made public, then do not accept the gift."

2. Moonlighting

The desire for extra income or personal and professional growth makes an engineer working in a company to support another company. He does what is popularly called PP (Private Practice) with them and sometimes it leaves him exhausted thereby harming job performance in his real company.

3. Working for Competitors, Customers or Suppliers

More often this involves leakage of information for some form of benefits. When one goes that morally low, even the beneficiaries stop trusting him further.

1.2 RESPONSIBILITY FOR SAFETY

A famous consultant of yonder years, William W. Lowrence opined: "A thing is safe if its risks re judged to be acceptable."

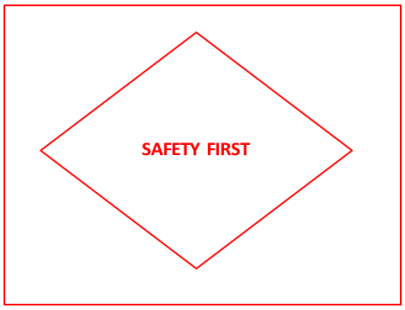
A responsible engineer must assess the rises of his experiments. Accidents and Disasters do occur, but knowing all the possibilities and proactively thinking of mitigation, drastically reduces if not eliminate their chances of occurrence.

The Oil and Aviation industries are known for their top priority to safety. Infact, in the oil industry, it is said that if it is not safe, don't do it.

1.2.1 SAFETY AND RISK

These two terms are inter-related. By reason of perception, what is safe for one may be harmful to another.

William D. Rowe said, "a risk is the potential for the realization of unwanted consequences from impending events."



1.2.2RISK MANAGEMENT

Risk can arise from these categories:

- ✓ Technical risks
- ✓ Organizational risks
- ✓ Project Management risks
- ✓ External risks

Wysocki (2009) opined that "effective project managers treat risk management as a dynamic part of every project."

Their plan has four parts as follows:

- ✓ Risk Identification
- ✓ Risk Assessment
- ✓ Risk Mitigation
- ✓ Risk Monitoring

Risks are commonly associated with losses – schedule slippage, cost increase or some catastrophic change. These losses being the mathematical product of the probability that an event will occur with known severity can therefore be estimated. This then is the reason why the project engineer or project manager makes a choice as to what to do to mitigate or reduce the losses.

According to Wysocki (2009), risks properly managed according to the above four phases answers the following questions:

☞ What are the risks?
☞ What is the probability of loss that results from them?
☞ How much are the losses likely to cost?
☞ What might the losses be if the worst happens?
☞ What are the alternatives?
☞ How can the losses be reduced or eliminated?
☞ Will the alternatives produce other risks?

1.2.2.1 RISK IDENTIFICATION

A typical risk identified on a project could involve the following

- Schedule is too aggressive
- Overambitious performance
- Too conservative a budget
- Unrealistic expectations
- Misunderstood contract terms
- New/unfamiliar technology
- Inadequate software sizing
- Unsuitable development model
- Unfamiliar new hardware
- Poorly defined requirements
- Frequently change requests
- Poorly defined process
- Volatile business environment
- Inadequately skilled personnel
- Continuous requirements changes
- Inadequate development plan
- Unsuitable organizational structure
- Testing facilities not available
- Poor software engineering methods
- Poor technology support
- Lack of political support for project
- Inconsistent client involvement
- Loss of critical team involvement
- Vendor/contractor relations
- Market/competitor pressures

All possible risks must be noted at first as the Risk drivers.

1.2.2.2 RISK ASSESSMENT

If the cost of avoiding a risk is greater than the expected loss, it can be ignored. An engineer cannot spend ₦1,000,000.00 in solving a ₦50,000.00 problem.

Risks may also be assessed on a Low, Medium and High scale. Risks could equally be accessed on worksheets as shown below.

Project Activity	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**Score**
Rqmnts Analysis	2	3	3	2	3	3	2	2	1	1	22
Specifications	2	1	3	2	2	2	1	2	2	3	20
Preliminary Design	1	1	2	2	2	2	1	2	2	2	17
Design	2	1	2	2	2	3	1	2	2	1	18
Implement	1	2	2	3	3	2	1	2	2	1	19
Test	2	2	2	2	2	3	2	2	2	2	21
Integration	3	2	3	3	3	3	2	3	3	2	27
Checkout	1	2	2	3	3	3	2	3	2	2	23
Operation	2	2	3	3	3	3	3	3	1	1	24
Score	16	16	22	22	23	24	15	21	17	15	191
Maximum score is 270. Risk level for this project is 191/270=71%											

1.2.2.3 RISK MITIGATION

Five risk responses are open to the project engineer:

i. Accept
ii. Avoid
iii. Contingency planning
iv. Mitigate
v. Transfer

1.2.2.4 RISK MONITORING AND CONTROL

After the risks are identified, probability assessed and plans made of what to do in the event the risk happens, the wise thing to do is to monitor and control the project risks.
A risk log is adopted with the following:

- ✓ ID number
- ✓ Risk description
- ✓ Risk owner
- ✓ Action to be taken
- ✓ Outcome

The risks are always kept in the front burner so that every project team member will be aware of them and know what is to be done in the event it happens.

1.3.3 THE GOVERNMENT'S POSITION

Risk management is to be viewed in a wider angle in case of disasters necessitated by improper care and assessment. It is the responsibility of government to take care of the people by protecting lives and property. An engineer who by reason of carelessness refuses to manage risks well should be aware that government would not look away or forgive.
The engineers in the Synagogue Church of All Nation collapse that claimed several lives are still being prosecuted by the Corona Court in Lagos state.
I'm in the know of an ongoing bill in the Delta state House of Assembly that only registered engineers with current practicing Licenses should engage in construction and maintenance works. Penalties for contravention are clearly spelt out.

1.4 BALANCED OUTLOOK ON LAW

Engineers practice is done within human society where there are established laws. Nobody is above the law, not even the nobleness of the engineering profession exonerates them from the law.
Living in harmony in society demands that a balance be maintained between individual and collective needs of people. With the help of laws, the ethical conduct helps in maintaining such balance.
Even in the past, examples of how laws have helped ethical conduct of engineers abound. Some examples are shown below:

1.4.1 BABYLON'S BUILDING CODE 1758 BC

Hammurabi, King of Babylon set this code to instil sanity in the builders of this time. It stated, "If a builder has built a house for a man and has not made his work sound, and the house which he has built was fallen down and so caused the death of the householder, that builder shall be put to death. If it causes the death of the house holder's son, they shall put that builder's son to death. If it causes the death of the house holder's slave, he shall give slave to the householder.
If it destroys property, he shall replace anything it has destroyed; and because he has not made the house sound which he has built and it has fallen down, he shall rebuild the house which has fallen down from his own property. If a builder shall put that wall into sound condition at his own cost".
The above code regulated builders of that time, though applies very little today.

1.4.2 THE UNITED STATES STEAMBOAT CODE OF 1852 AD

Very heavy and bulky steam engines were employed for travel in those days. Despite the modifications of scientist like Oliver Evans and Richard Trevithick on James Watt's invented steam engine by removing their condensers to make them compact, they still remained very heavy while boilers explosions remained.
Increased boat speed led to explosion of boilers on steam boats leading to disasters. Engineer Alfred Guthrie of Illinois then inspected 200 steam boats with personal finances and discovered the reasons for the boiler explosion. He prepared a report on that with the care that could avert it as recommendations. An Illinois senator shields incorporated the recommendation in senate documents which were later passed as law. Thus, the American society of Mechanical Engineers (ASME) adopted it in formulating the standards for steam boats manufacture.

1.4.3 THE CHALLENGER CASE STUDY

The explosion of the space shuttle known as challenger is among the familiar known accidents. It was purely an ethical issue. It occurred on January 28, 1986. The challenger space shuttle principally consisted of two solid propellent boosters, orbiter and a single liquid-propeller booster designed to be reusable.
All the boosters were ignited as the orbiter took a lift-off the earth. However, the O-rings were eroded due to trouble caused by cold temperature.

Tutorials Point said, “The debacle highlights how lack of responsibility and morality, improper function, and lax performance of duties of the engineers resulted in the failure of the launch,” even after Rogers commission was set up by President Reagan.

1.4.4 THE PROHIBITION OF NON-ENGINEERS FROM PRACTICING ENGINEERING AND FOR 1.4.5 OTHER MATTERS CONNECTED THEREWITH BILL IN DELTA STATE, NIGERIA.

This welcome development will scare quacks off the practice of Engineering when enacted into law in Delta state. Sanity would be maintained by practitioners to update their practicing licenses also. The issue of building collapse and infrastructural failure would be eliminated or greatly curbed.

1.5 GLOBAL ISSUES

Engineering ethics transcends global issues.

The integration of nations through trade, investment, exchange of ideas and culture, and transfer of technology is increased by the concept of globalization. Multinational companies play crucial roles in enhancing globalization.

1.5.1TRANSNATIONAL (MULTINATIONAL) COMPANIES

International Labour Organization (ILO) defines transnational companies as those with main branch at Home country and other branches in different countries known as Host countries.

Not only do multinationals play vital roles in enhancing international relations and globalization, they equally powerfully influence local and world economies. Because they help in increasing the national GDP, multinationals some benefits in return including: pledges of government assistance, improved infrastructure, lax environmental and labour standards enforcement, and tax benefits.

Government expects high standards of operational efficiency wherever they are. Their safety measures, employee wages and benefits should be top class. Nevertheless areas of confrontation between multinationals and governments include: forcing multinationals to reveal to the public their intellectual property so as to gain technology for local entrepreneurs, threat of nationalization or changes in local business laws. Most often the above leads to withdrawal of investments by multinationals.

1.5.2 BUSINESS ETHICS

The aspects of business dealing with all employees and stakeholders in an ethical manner is called business ethics.

The expectation from organizations is that they abide by certain ethical values in the establishment, operations and functioning, employee welfare, waste management, environmental factors, corporate social responsibility, host community relationship, etc. Note that the reputation of a company which indirectly affect the share values in the global market are determined by the above listed ethical values. Most importantly, admirable business ethics include: open mindedness, meeting obligations, trust worthiness, good accounting control.

1.5.3 ENVIRONMENT ETHICS

The environment have been greatly impacted by globalization and industrialization. The ill effects of pollution and industrial negligence are common place as the aftermath of water and land contamination, acid rains, drying of lakes and canals, drought, foods, earthquakes and tsunamis (from drilling underground wealth), crops and food sources thinning away, cattle getting affected, etc. Thus marine beings are affected, ozone layer is depleted and Snow Mountains melt due to global warming.

Engineers must therefore show responsibility towards the environment.

Their approvals must be ethical so as to find mitigating solutions in protecting and preserving the environment. Environmental protection must therefore be supported in the activities of organizations.

1.5.4COMPUTER ETHICS

This is actually a new area of applied ethics called computer ethics. Concerned professionals here are programmers, operators, designers, analysts, and users. A host of issues such as basic moral concerns including free speech, privacy, informed consent, respect for property and harm are raised by computers with internet, the hate speech bill at the senate currently has its fulcrum keyed in the above issues.

The computer Ethics Institute (1992) adopted what is popularly known as the ten commandments of computer Ethics. They are – That one should never use a computer to do the following:

1. To harm the people (anti-social activities).
2. To interfere with other’s work (illegal manipulation).
3. To snoop into other’s files (malware).
4. To steal a computer/data (hacking).

5. To bear false witness (manipulation and morphing).
6. To use/copy a software you didn't pay for (like illegal downloads and usages).
7. To use or copy other's software without compensations (illegal pirated versions).
8. To use other's intellectual output inappropriately (violating IPR).
9. Doing without thinking of social consequences of the program being written (libeling).
10. Always use a computer ensuring consideration and respect towards fellow beings.

The unprecedented cybercrime worldwide today is a proof to the fact that the entire world is lax concerning these ethics. Privacy factors are greatly threatened by illegal attackers or hackers despite the huge role of computers in technological advancement.

1.6 GENERAL RESPONSIBILITIES OF ENGINEERS

A few important virtues in engineering professionalism are:

- ☞ Loyalty to organization
- ☞ Respect for authority
- ☞ Collegiality and teamwork

1.6.1 LOYALTY

Loyalty calls for faithful adherence to an employer and organization. Two types of loyalty are:

1. Agency Loyalty – Doing one's job and acting to fulfil one's contractual obligation to an employer. One ensures he never steals from his employer.
2. Altitude Loyalty – Altitudes, emotions and a sense of personal identity are involved here. Thus, working grudgingly and spitefully despite performing all work responsibilities to manifest agency loyalty is not loyalty Afterall.

1.6.2 RESPECT FOR AUTHORITY

Organizational goals are met by professionals who have respect for authority. Personal responsibility and accountability can be identified based on the levels of authority maintained by the organization. The major types of authority are:

1. Executive Authority – This refers to the institutional, organizational or corporate right accorded in person to exercise power based on available resources of an organization.
2. Expert Authority – This implies those equipped with competence, skill or special knowledge to perform a defined task or give sound advice.

An engineering oriented or service oriented organization concentrates on products quality, time and cost. These are decided by engineers who are the subject matter experts in this case.

A customer oriented organization on the other hand primarily focuses on customer satisfaction. Thus, the company goal decides the power between an Engineer or Technical Manager and a General Manager.

1.6.3 COLLEGIALITY

This is a term for a work environment where authority and responsibility are shared among colleagues.

Tutorials Point (2020) opine that "the disloyalty of professionals towards an organization, reflects the altitude they have towards the work environment for the salaries they are paid and the trust the company has for them.
Example – The National Society of Professional Engineers (NSPE) code posit "Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action."

Harmony among members in a workplace is maintained through:
- ✓ Respect
- ✓ Commitment, and
- ✓ Connectedness

In so doing mutual respect for others contribution, the dedication towards the social goods as promoted by the profession; commitment by way of sharing a devotion regarding the intrinsic moral ideas of engineering; and the knowledge of participating in cooperative projects based on coordination amongst team members leads to excellence in output executed on time and to budget.

1.7 PROFESSIONAL ENGINEERING REQUIREMENTS

The services provided by engineers require:
- ✓ Honesty
- ✓ Impartiality
- ✓ Fairness and equity, and
- ✓ Must be dedicated to the protection of public health, safety, and welfare. Security has also become vital.

Engineers must always note the following while fulfilling their professional duties:
- ✓ Perform services only in the area of their competence.
- ✓ Hold paramount the safety, health, welfare and now security of the public.
- ✓ Act for each employer or client as faithful agents or trustees.
- ✓ Avoid deceptive acts.
- ✓ Issue public statements only in a truthful and objective manner
- ✓ Conduct themselves responsibly, honourably, ethically and lawfully so as to enhance the honour, reputation and usefulness of the profession.

It must be noted that societies and associations have the code of ethics to be followed by engineers in their own respective disciplines, in acting responsibly towards the profession while being in ethical limits, thus moral concerns should always accompany professional ethics.

CONCLUSION

How developed Nigeria is today calls to question how skillful and ethical we are individually and collectively in our various engineering fields and practices.
Professional ethics guarantee professional order discipline and virtue. While order is life, virtue dictates superiority. Without Professional decency, decorum and order, lawlessness and anarchy sets into the detriment of all round advancement. We must strictly follow the engineering code of conduct as prepared by the NSE, COREN, our various branches and also best practices to make real progress and contribute to societal development.
Nigeria's Human Development Index (HDI) between 2010 and 2019 are just marginally different (0.5)
Countries with higher HDI are obviously more technologically advanced. If Nigeria must advance higher

technologically, engineers, technologists, technicians and artisans must latch on germane policies of government such as local content on the foundation of a well oiled and soundly oriented ethical professional practices.

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